

# **UPPER LIMB**

Anatomy & Physiology I

# FUNCTIONS

- Designed for extensive motion
  - Manipulative appendage
  - Operate devices
  - Frequently injured because of its functions



# ACTION

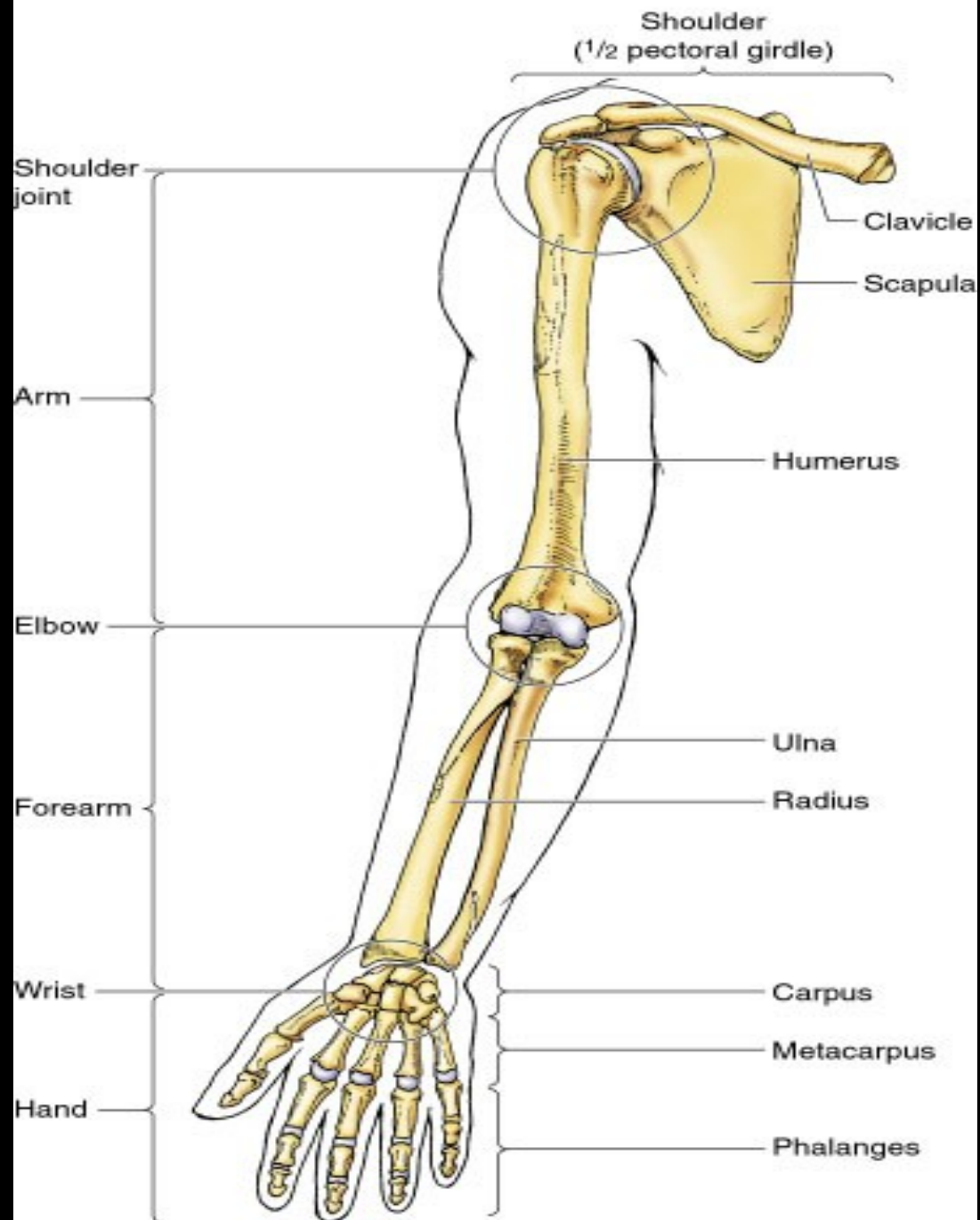
- Circumduction
- Flexion vs extension
- Abduction vs adduction
- Retraction
- “Winging”

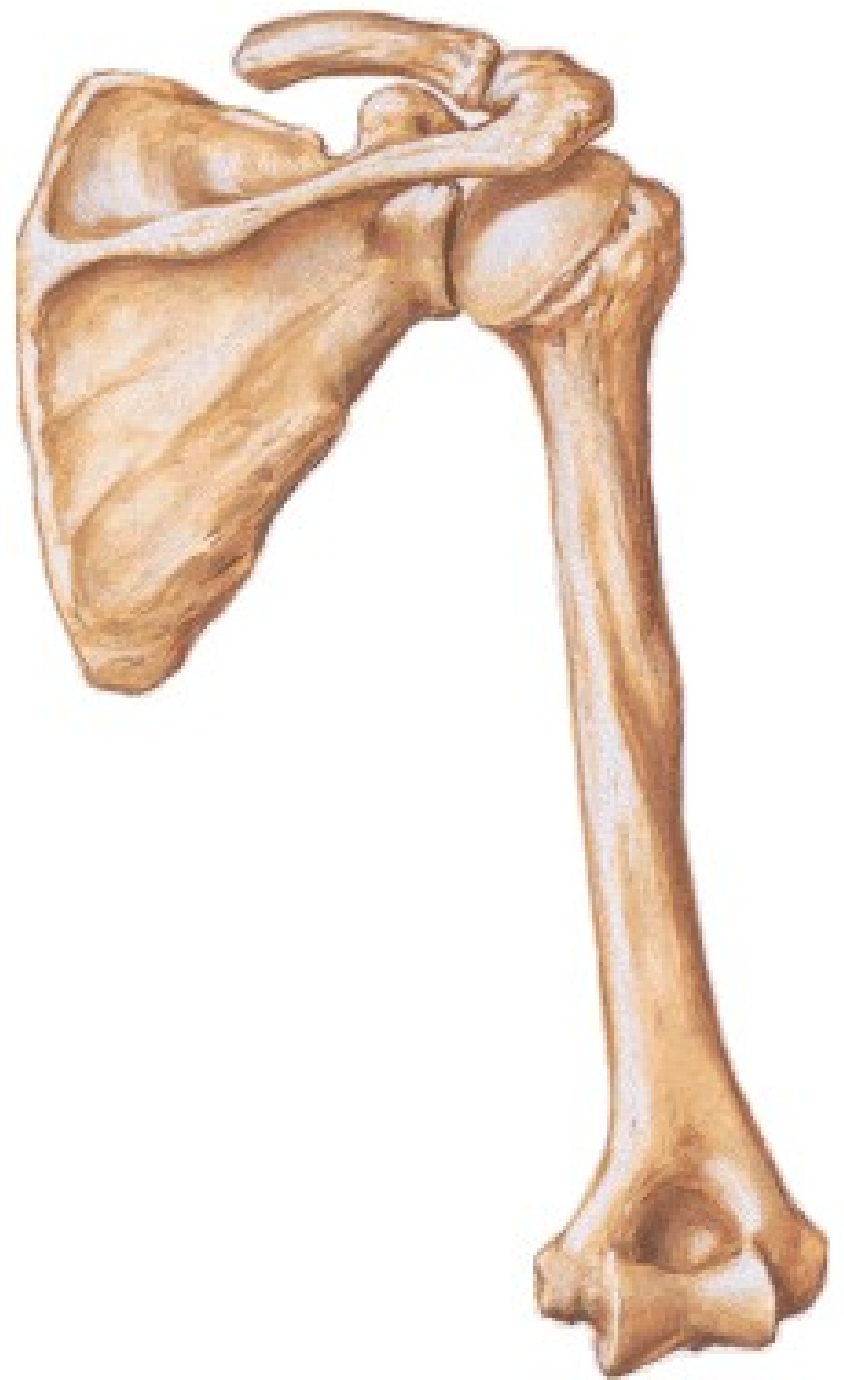
# THE SHOULDER AREA

# BONES OF THE SHOULDER & UPPER ARM

- Pectoral girdle
  - Clavicle
  - Scapula
- Shoulder joint
  - Scapula (& clavicle)
  - Humerus

6.1. Regions and bones of the upper limb.



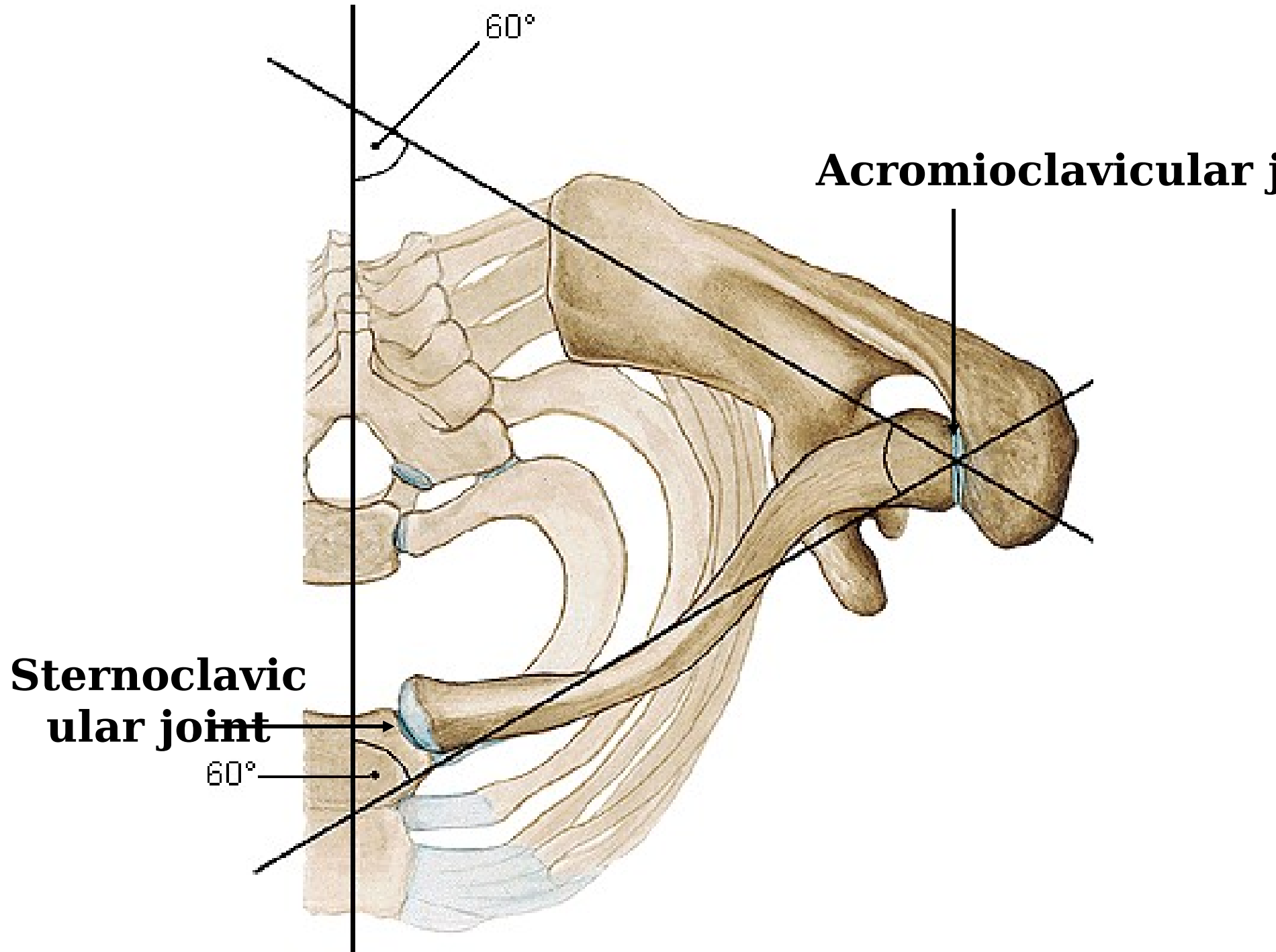


# **Pectoral Girdle**

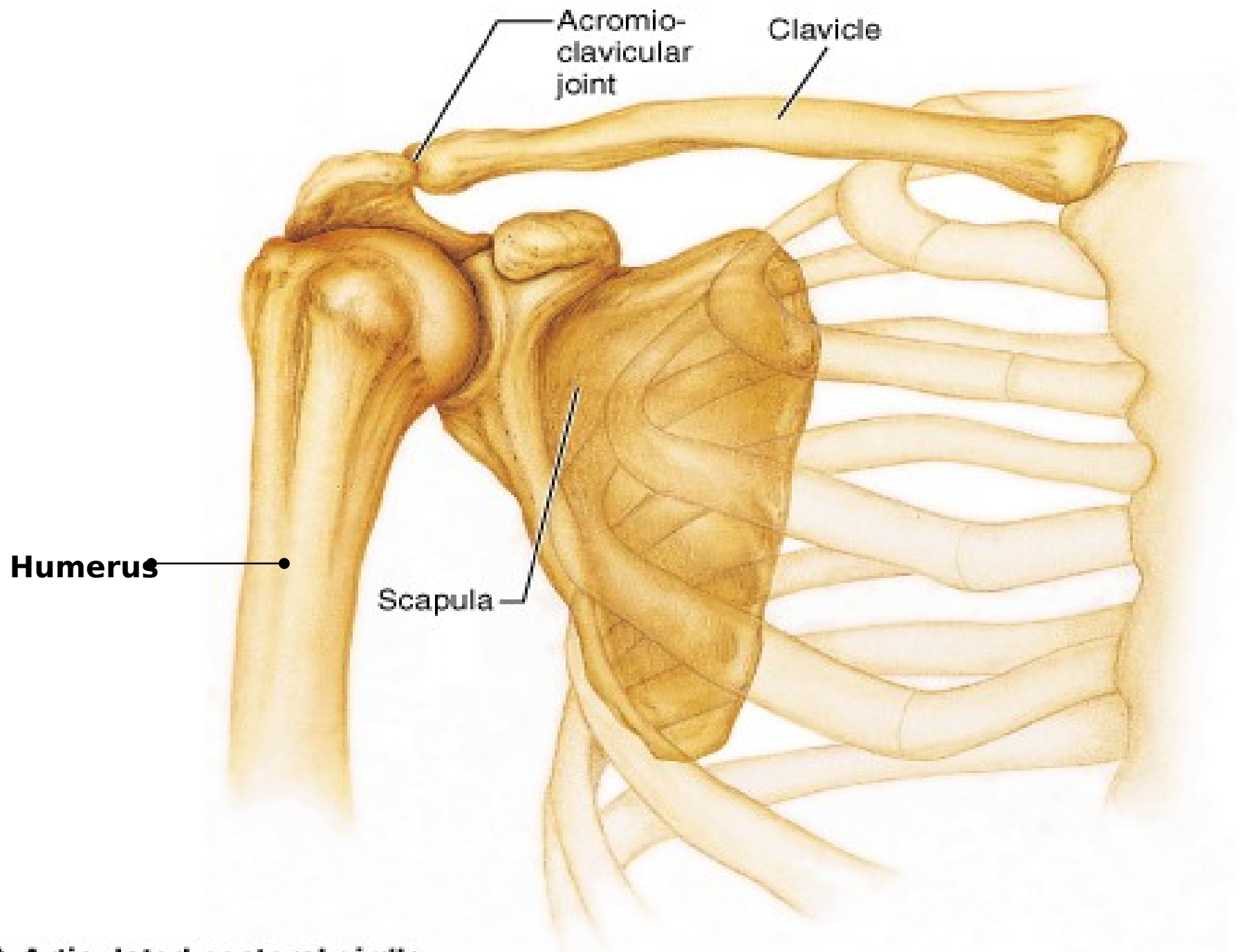
**Clavicle**

**Scapula**

**CLAVICLE**

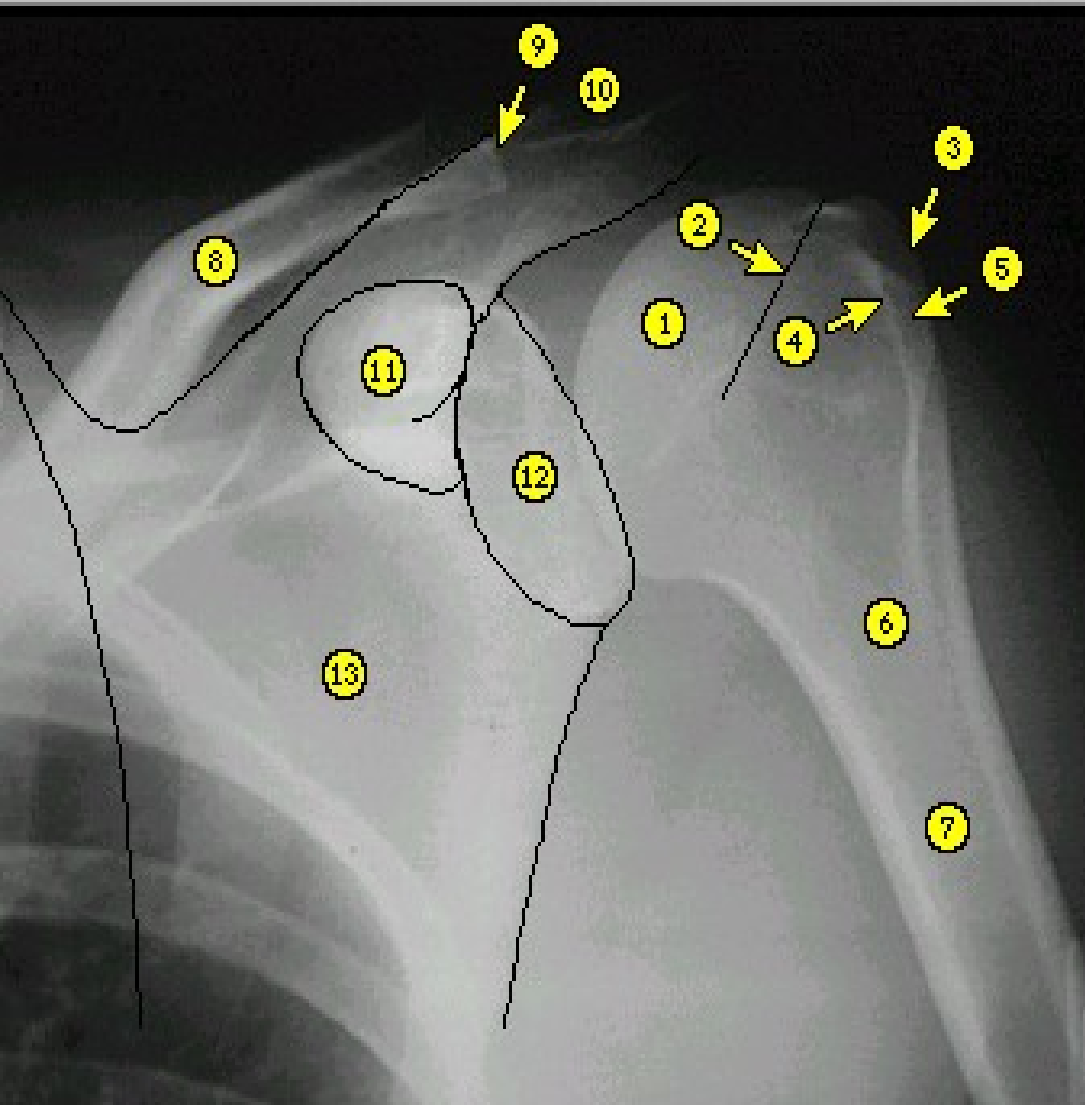






**(a) Articulated pectoral girdle**

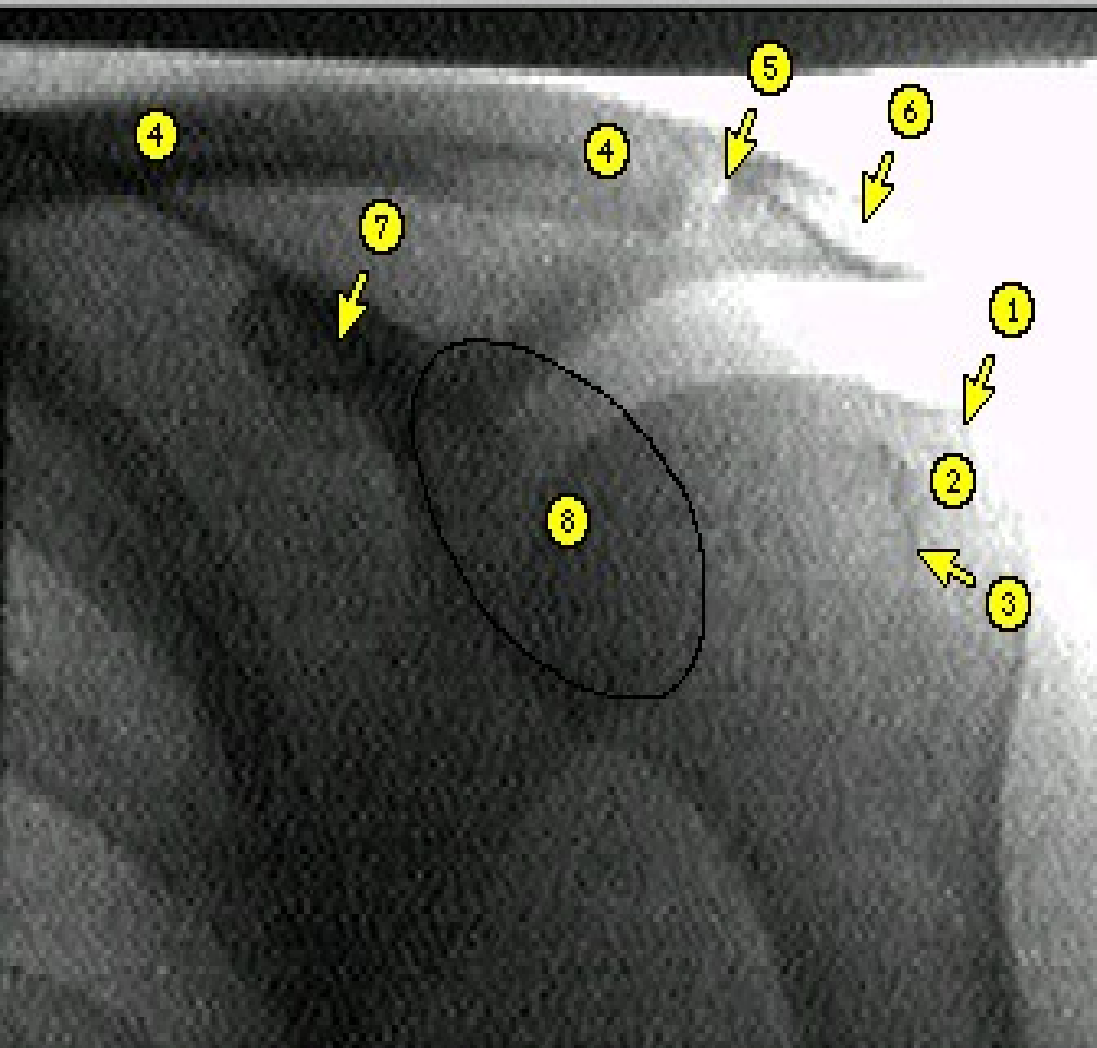
## AP Shoulder (External Rotation)



## Bones and Joints

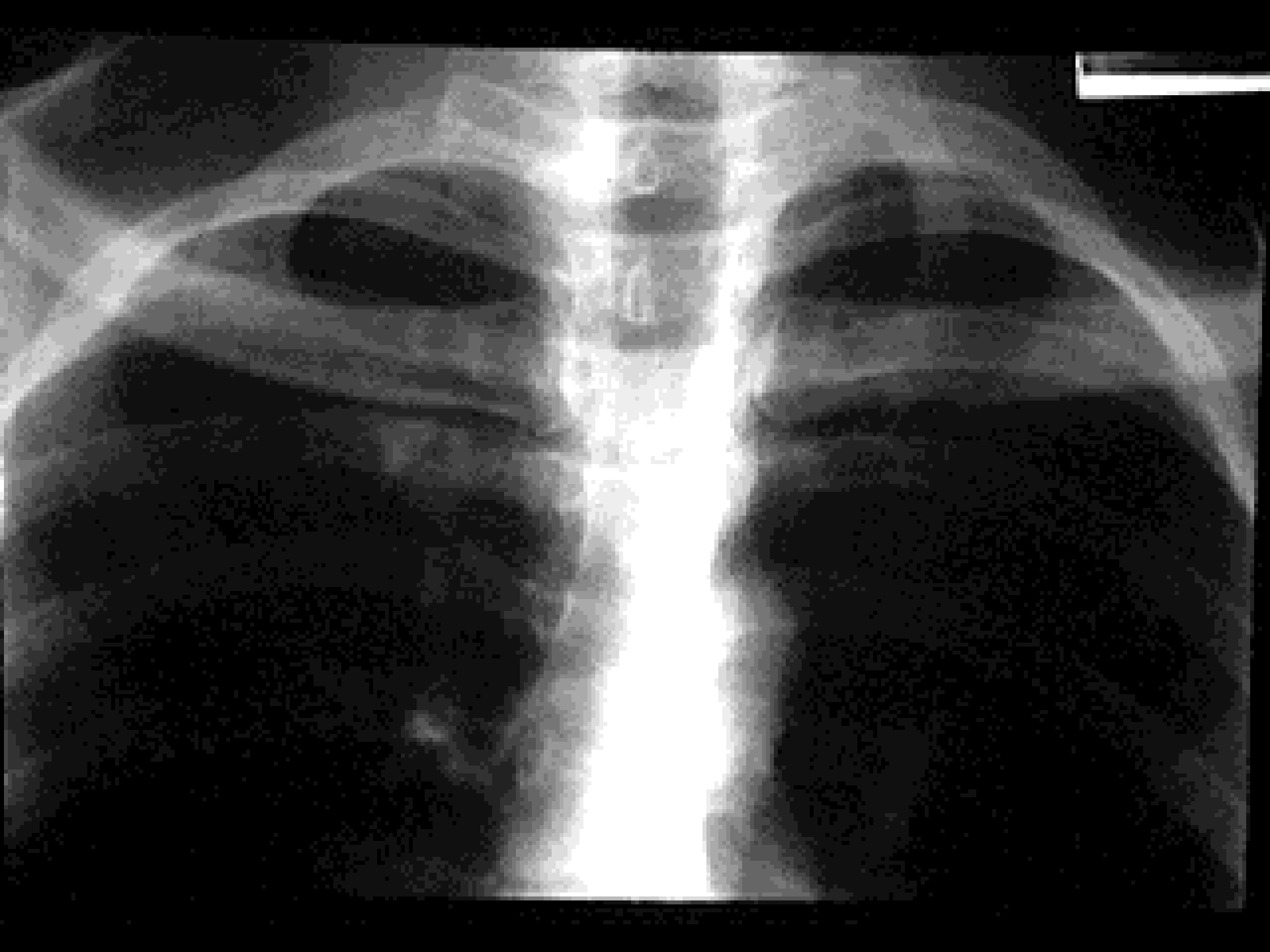
- 1-head of humerus
- 2-anatomical neck of humerus
- 3-greater tubercle of humerus
- 4-lesser tubercle of humerus
- 5-intertubercular groove of humerus
- 6-surgical neck of humerus
- 7-shaft of humerus
- 8-clavicle
- 9-AC joint
- 10-acromion
- 11-coracoid
- 12-glenoid
- 13-scapula (body)

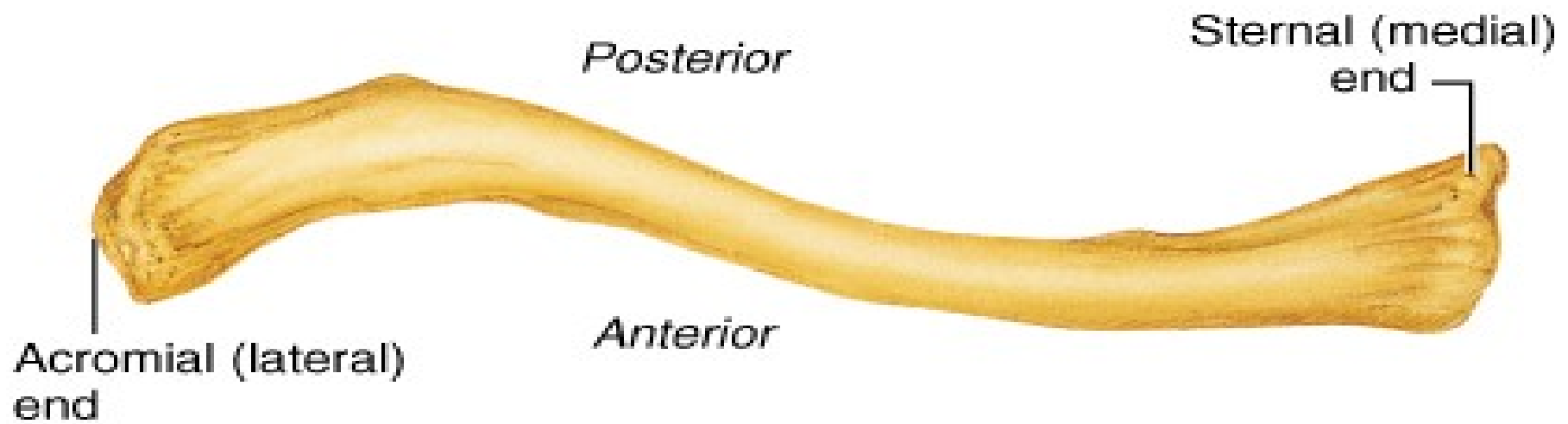
## Fluoroscopy, Shoulder



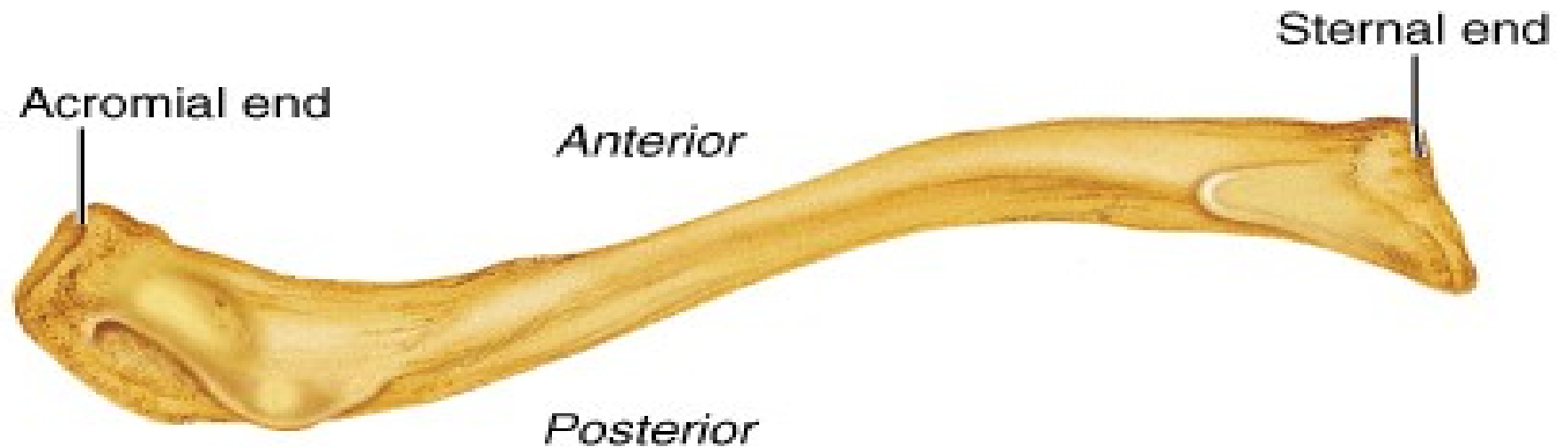
## Bones and Joints

- 1-greater tubercle of humerus
- 2-intertubercular groove of humerus
- 3-lesser tubercle of humerus
- 4-clavicle
- 5-AC joint
- 6-acromion
- 7-coracoid
- 8-glenoid



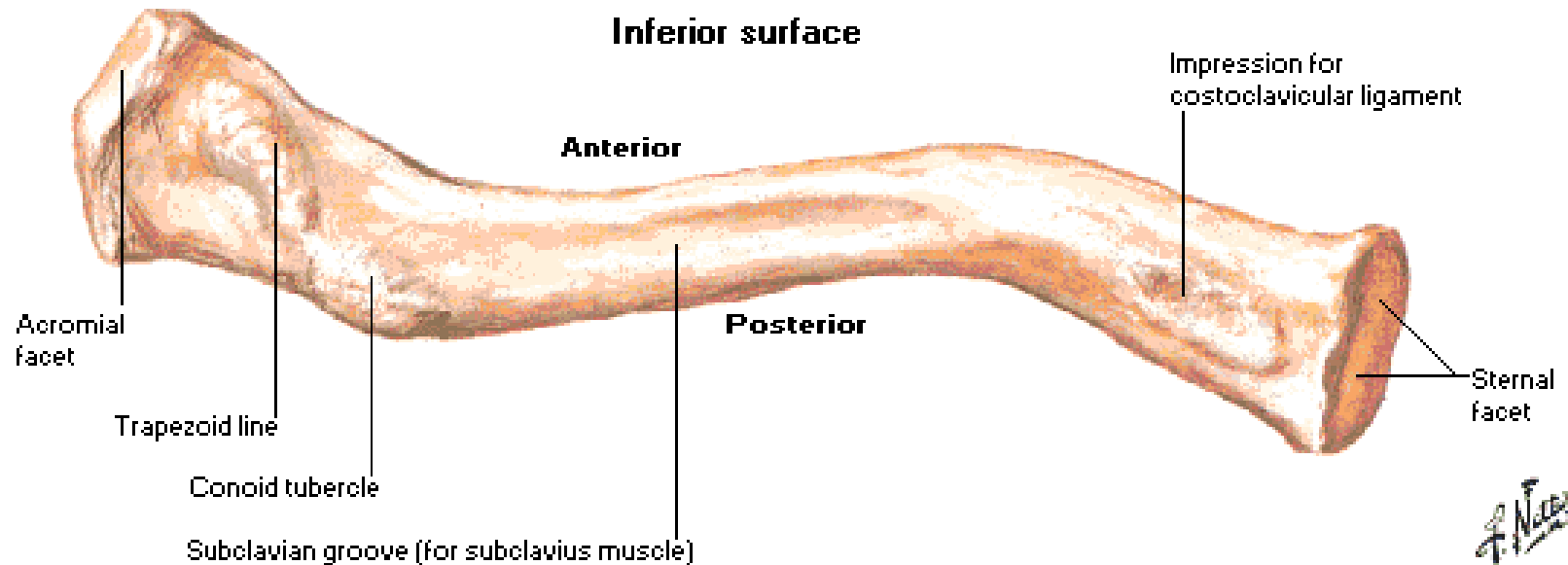
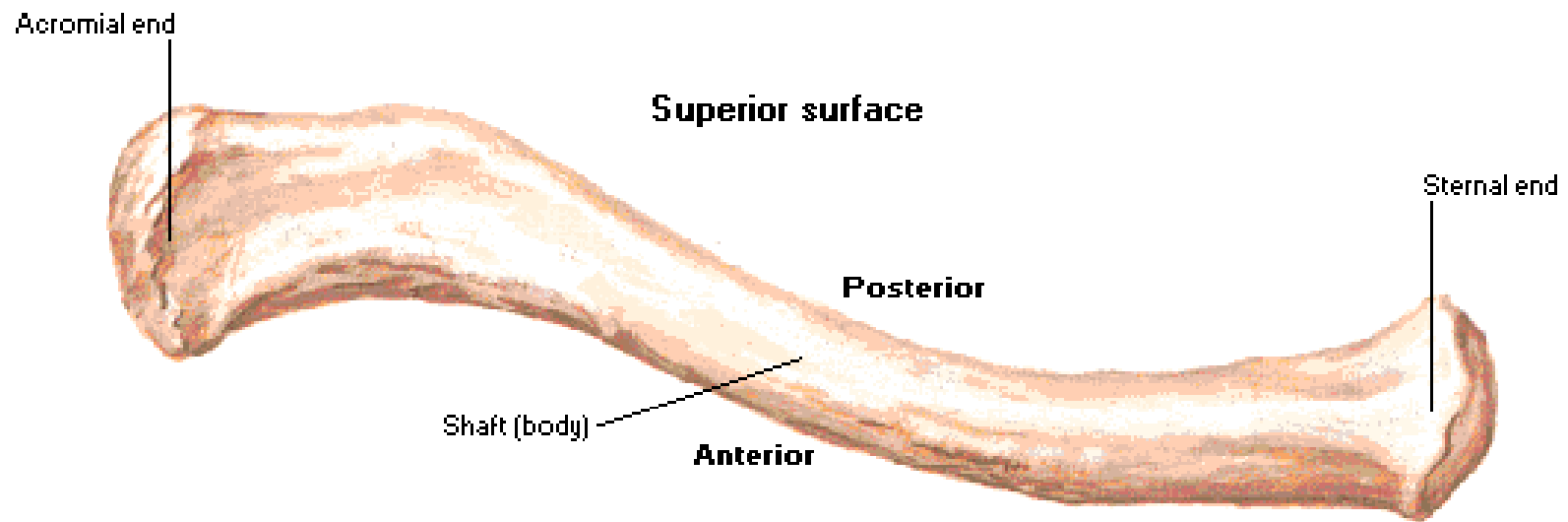


**(b) Right clavicle, superior view**



**(c) Right clavicle, inferior view**

# Right Clavicle - Features

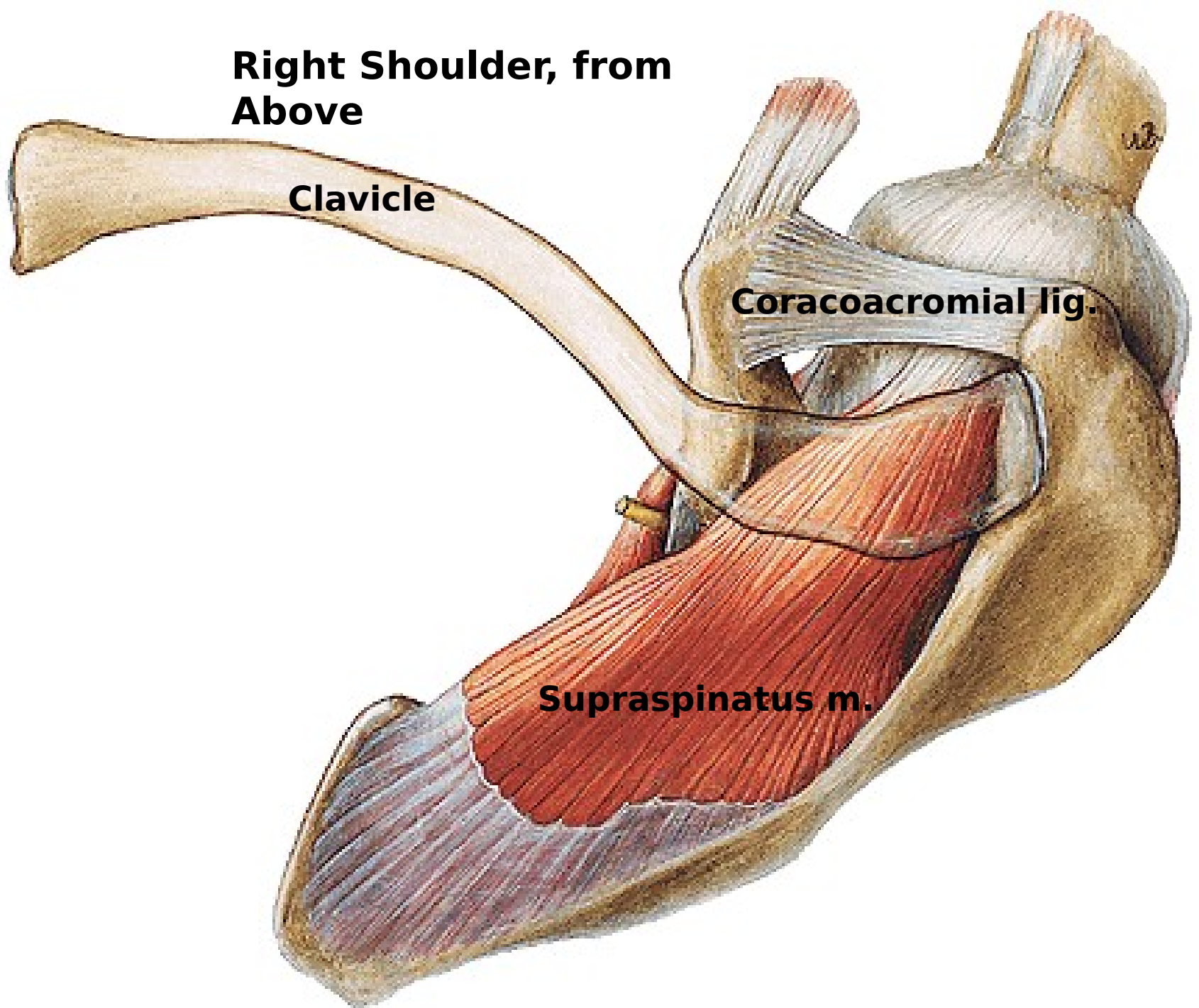


**Right Shoulder, from  
Above**

**Clavicle**

**Coracoacromial lig.**

**Supraspinatus m.**



# Ossification

- The clavicle begins to ossify before any other bone in the body; it is ossified from *three* centers—viz., two primary centers, a medial and a lateral, for the body, which appear during the fifth or sixth week of fetal life; and a secondary center for the sternal end, which appears about the eighteenth or twentieth year, and unites with the rest of the bone about the twenty-fifth year.



# Function

- The clavicle acts especially as a **fulcrum** to enable the muscles to give lateral motion to the arm.
- It is absent in those animals whose fore-limbs are used only for progression, but is present for the most part in animals whose anterior extremities are clawed and used for prehension.

**SCAPULA**

LEFT

# SCAPULA



**Anterior View**



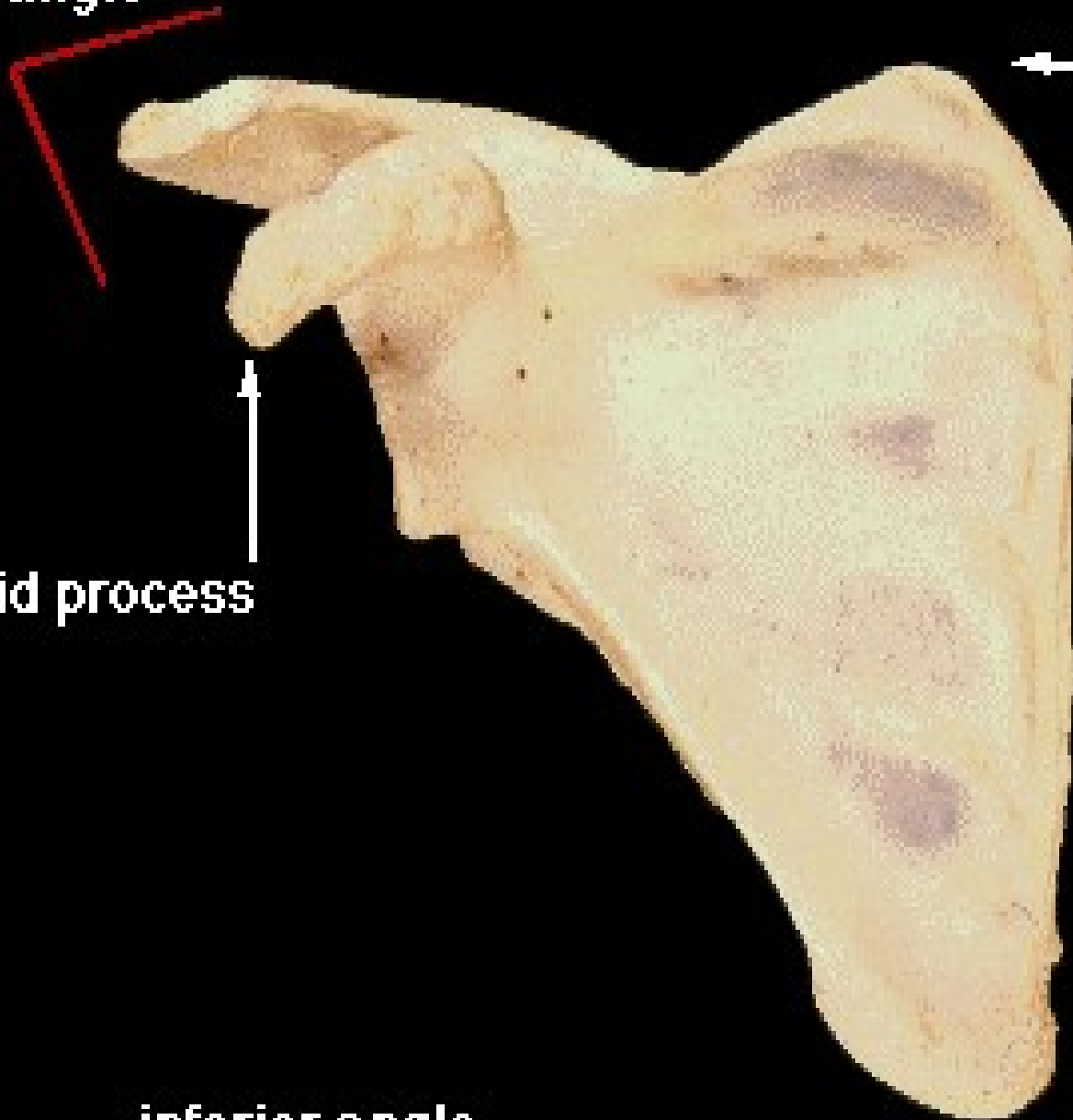
**Lateral View**

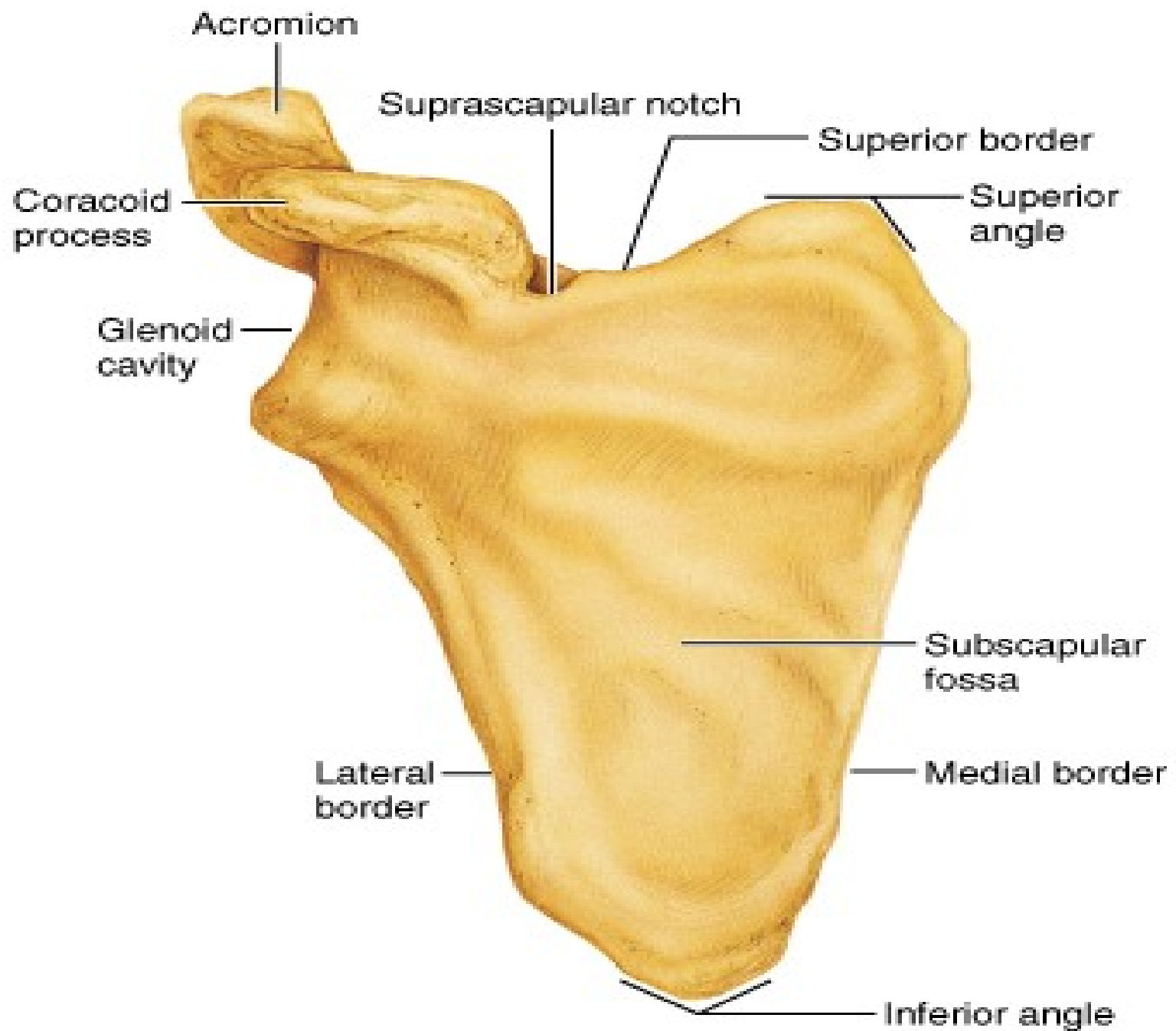
lateral angle

superior angle

coracoid process

inferior angle





**(d) Right scapula, anterior aspect**

# SCAPULA

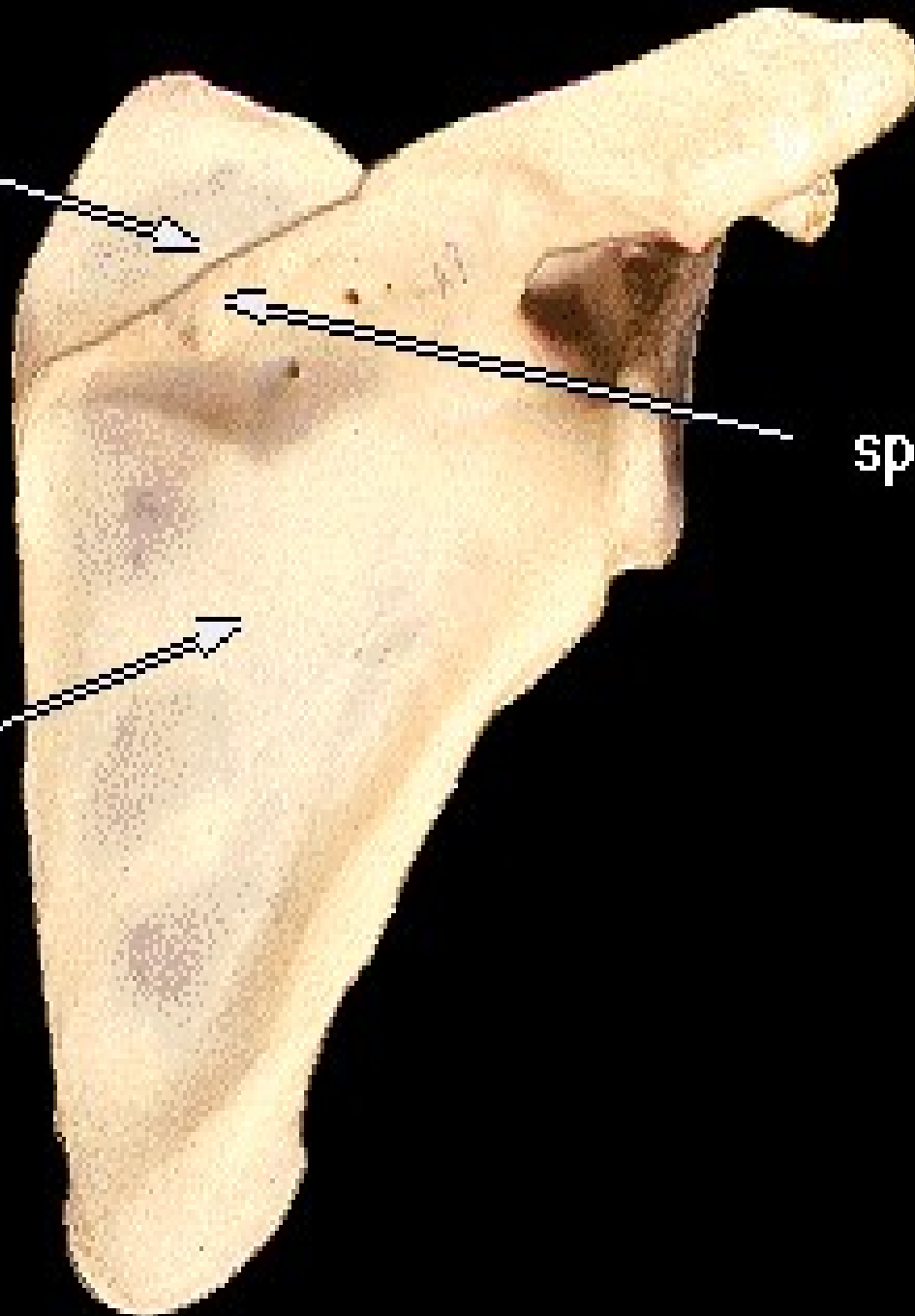


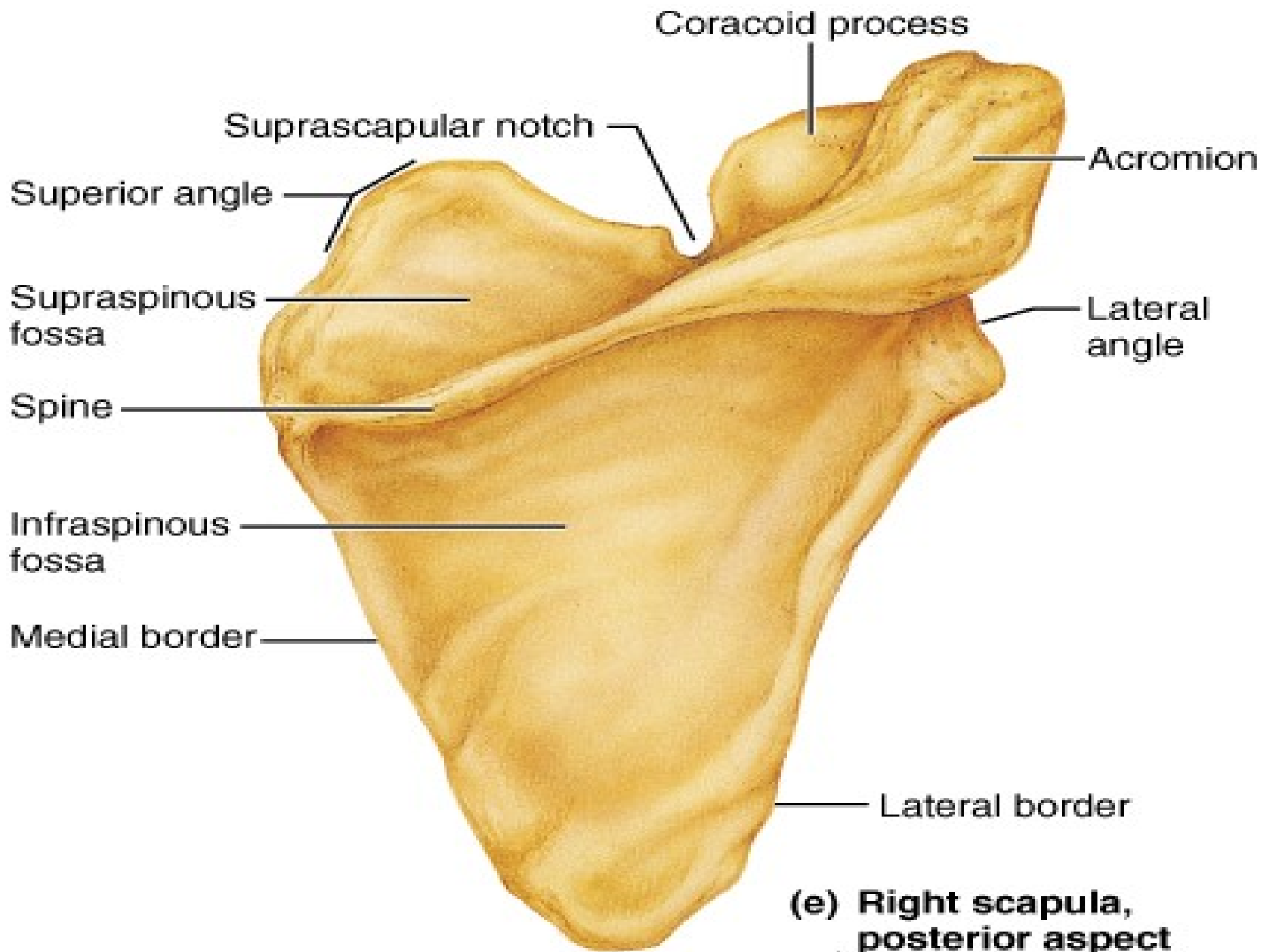
supraspinous  
fossa

← acromion  
process

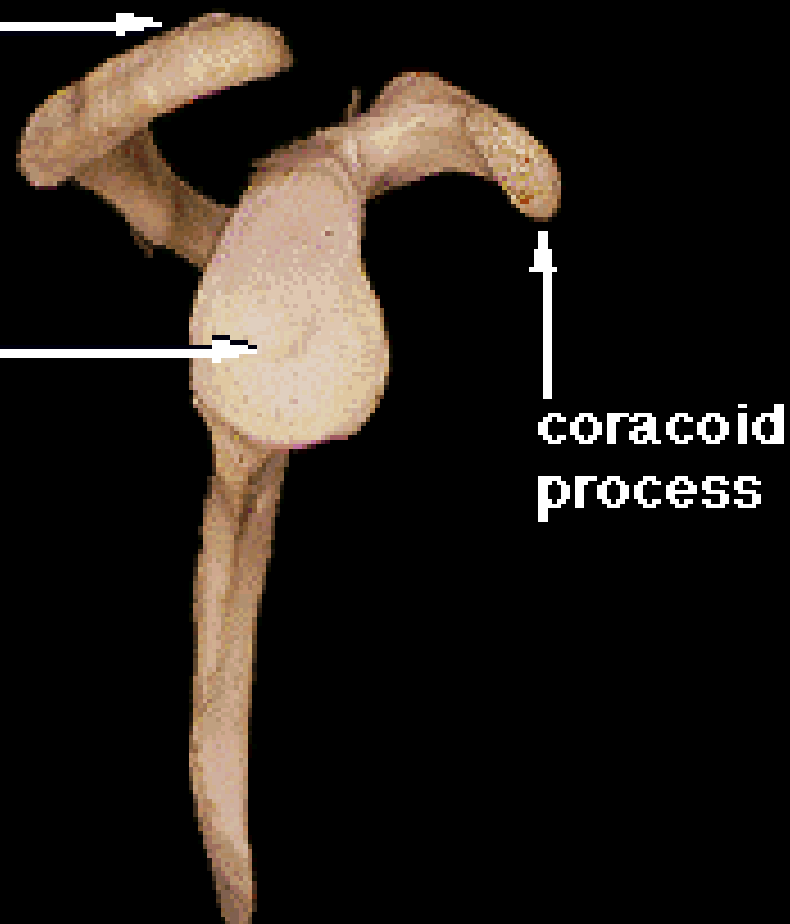
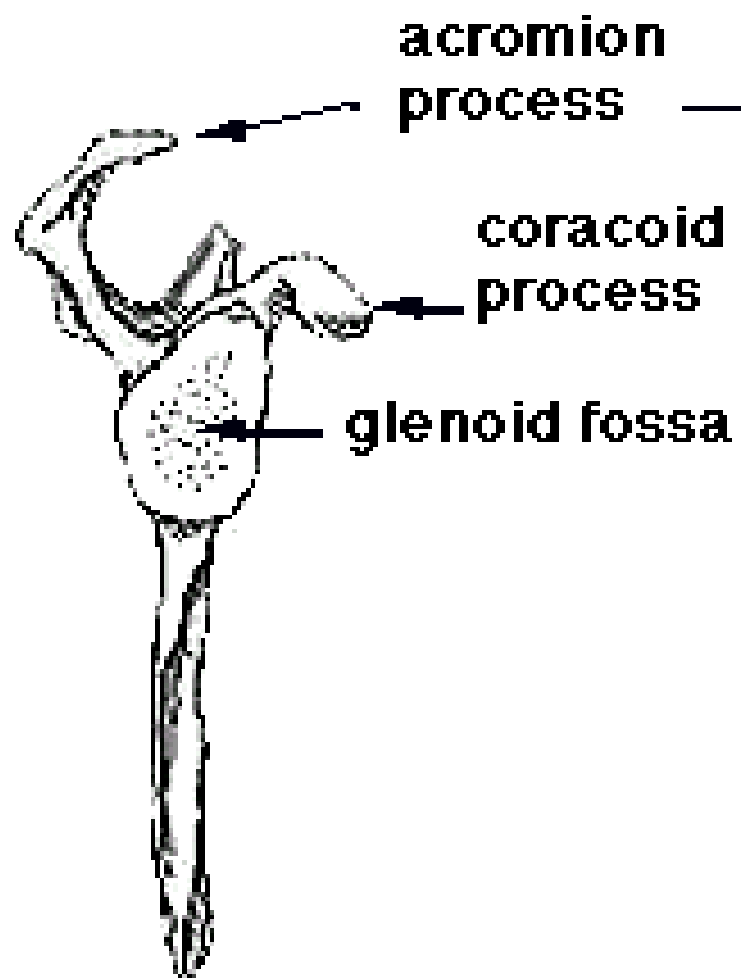
spine

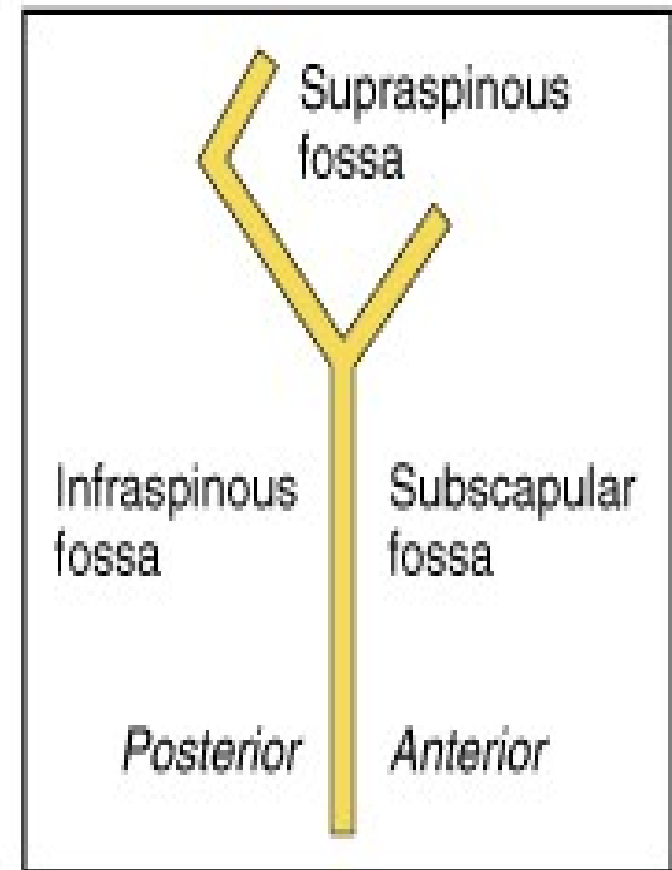
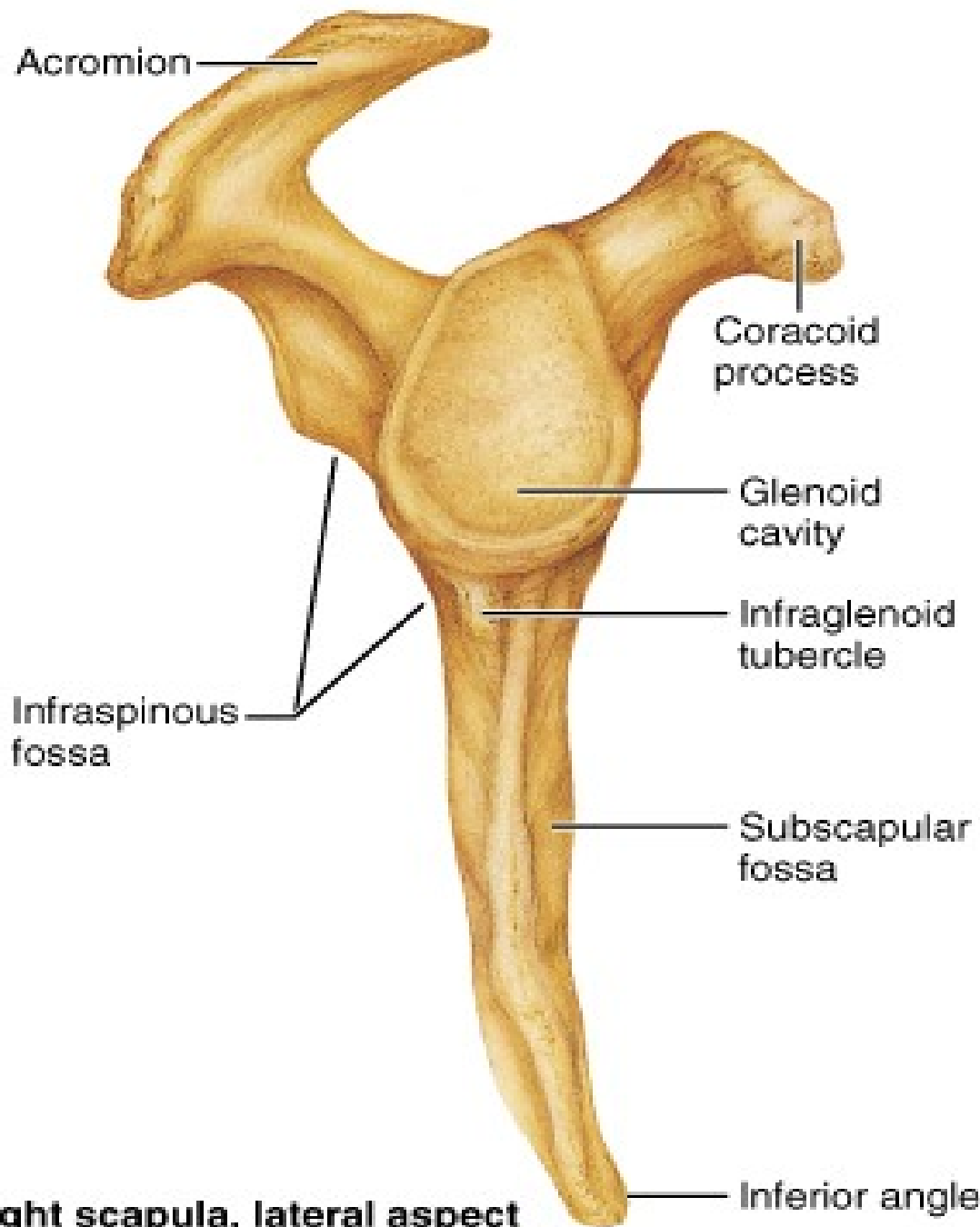
infraspinous  
fossa

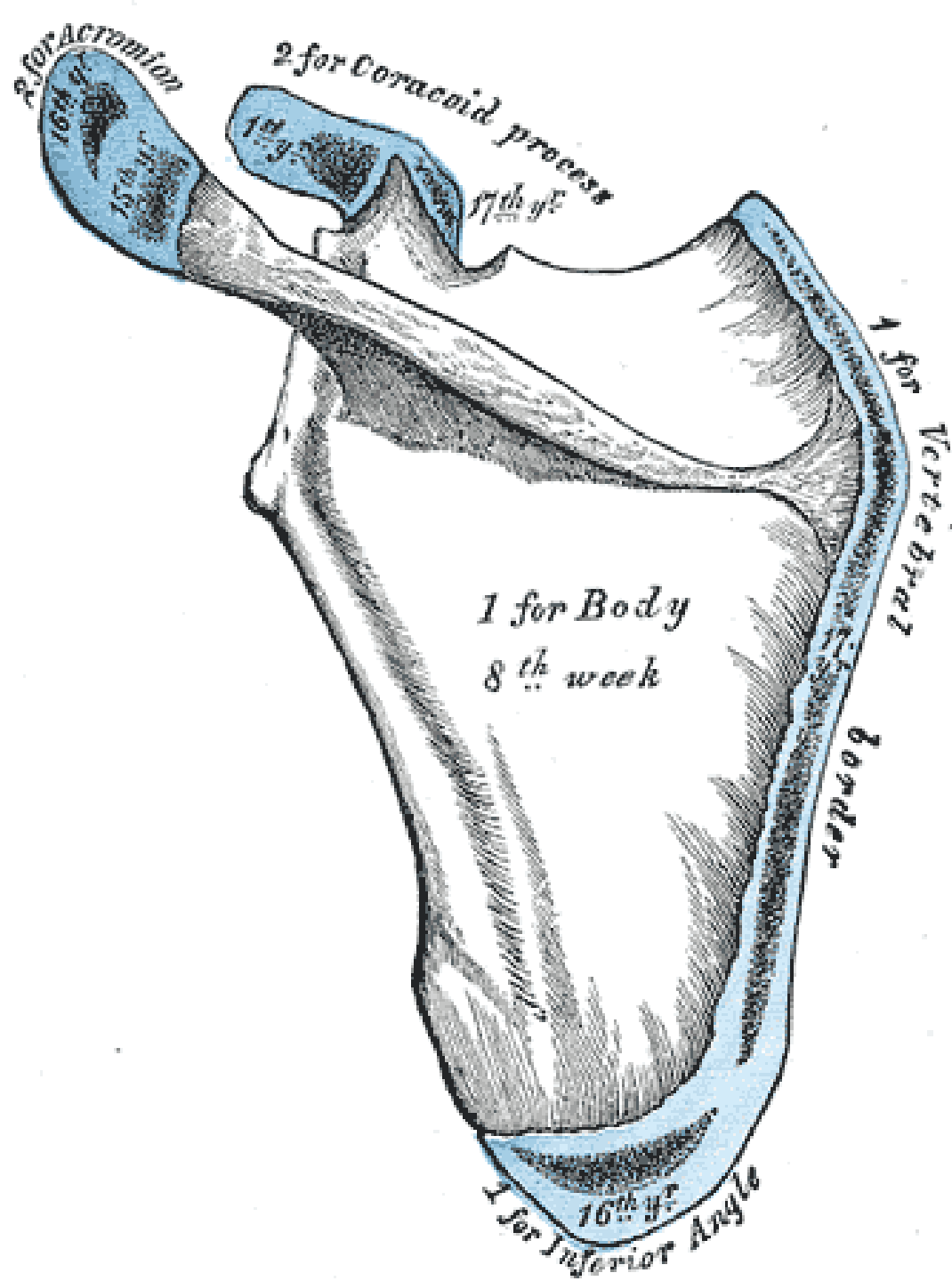












**HUMERUS**

head of humerus



- 1) Head
- 2) Anatomical neck
- 3) Surgical neck
- 4) Greater tubercle
- 5) Lesser tubercle
- 6) Intertubercular groove
- 7) Deltoid tuberosity
- 8) M. epicondyle
- 9) L. epicondyle
- 10) Trochlea
- 11) Capitulum
- 12) Coronoid fossa
- 13) Olecranon fossa

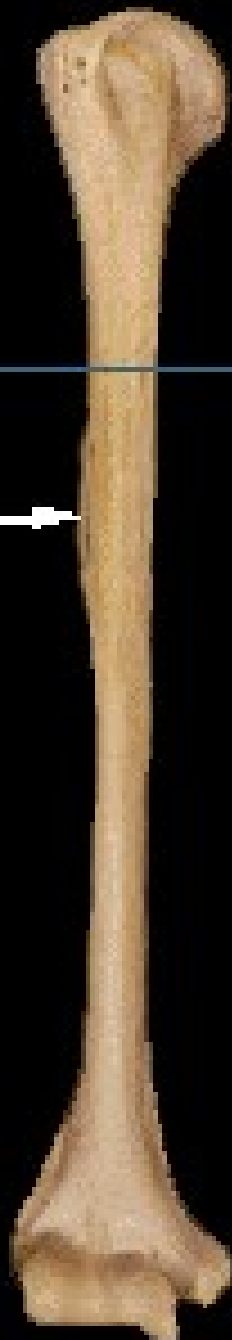
**Anterior View**



**Posterior View**



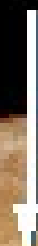
**deltoid  
tuberosity**



**greater  
tubercle**

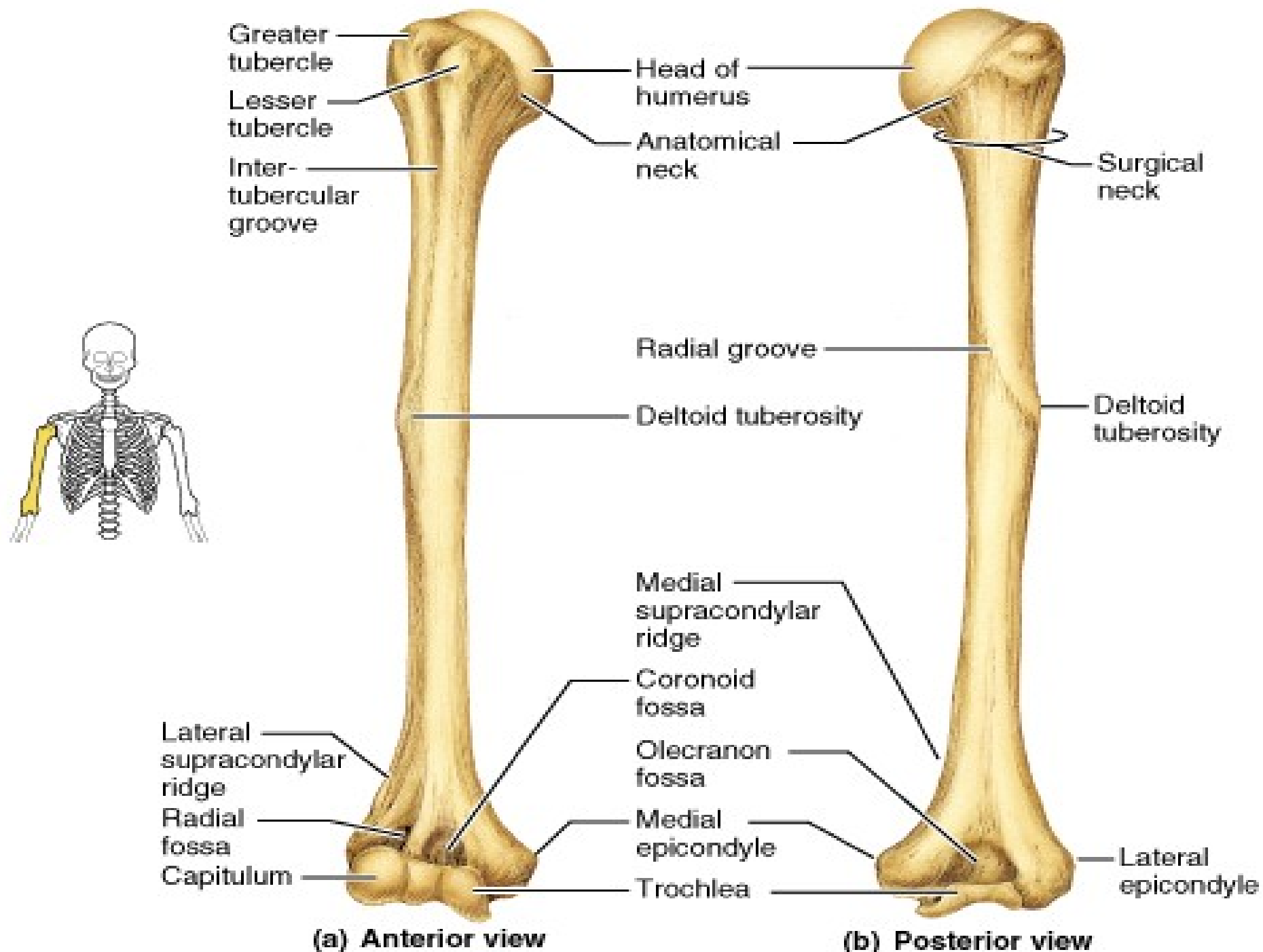


**lesser  
tubercle**

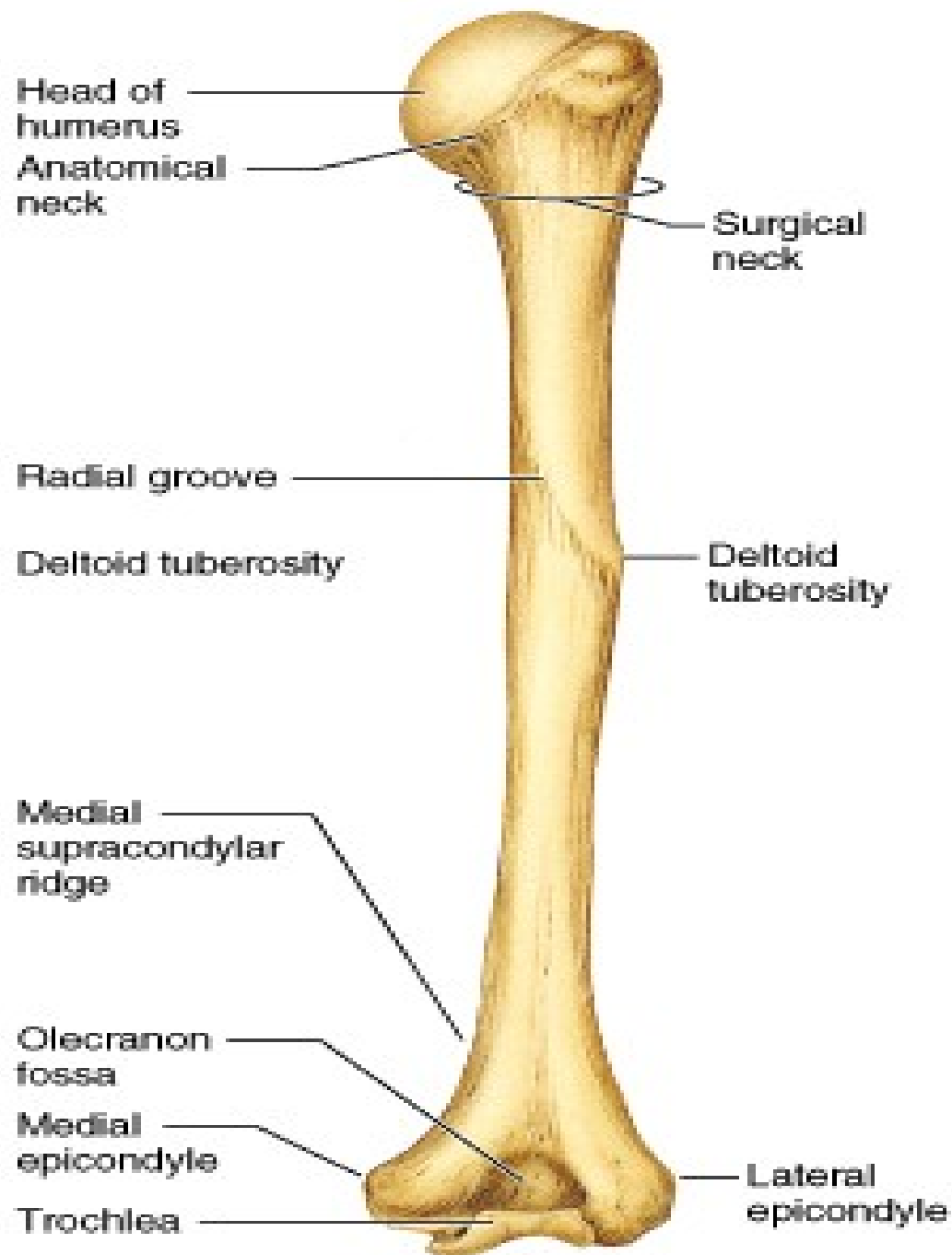


**bicipital  
groove**







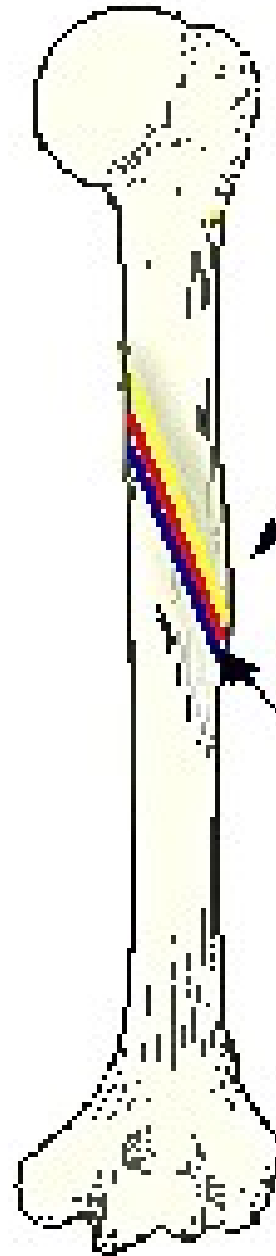


**(b) Posterior view**



**deltoid  
tuberosity**

**radial  
groove**



**deltoid  
tuberosity**

**radial  
groove**

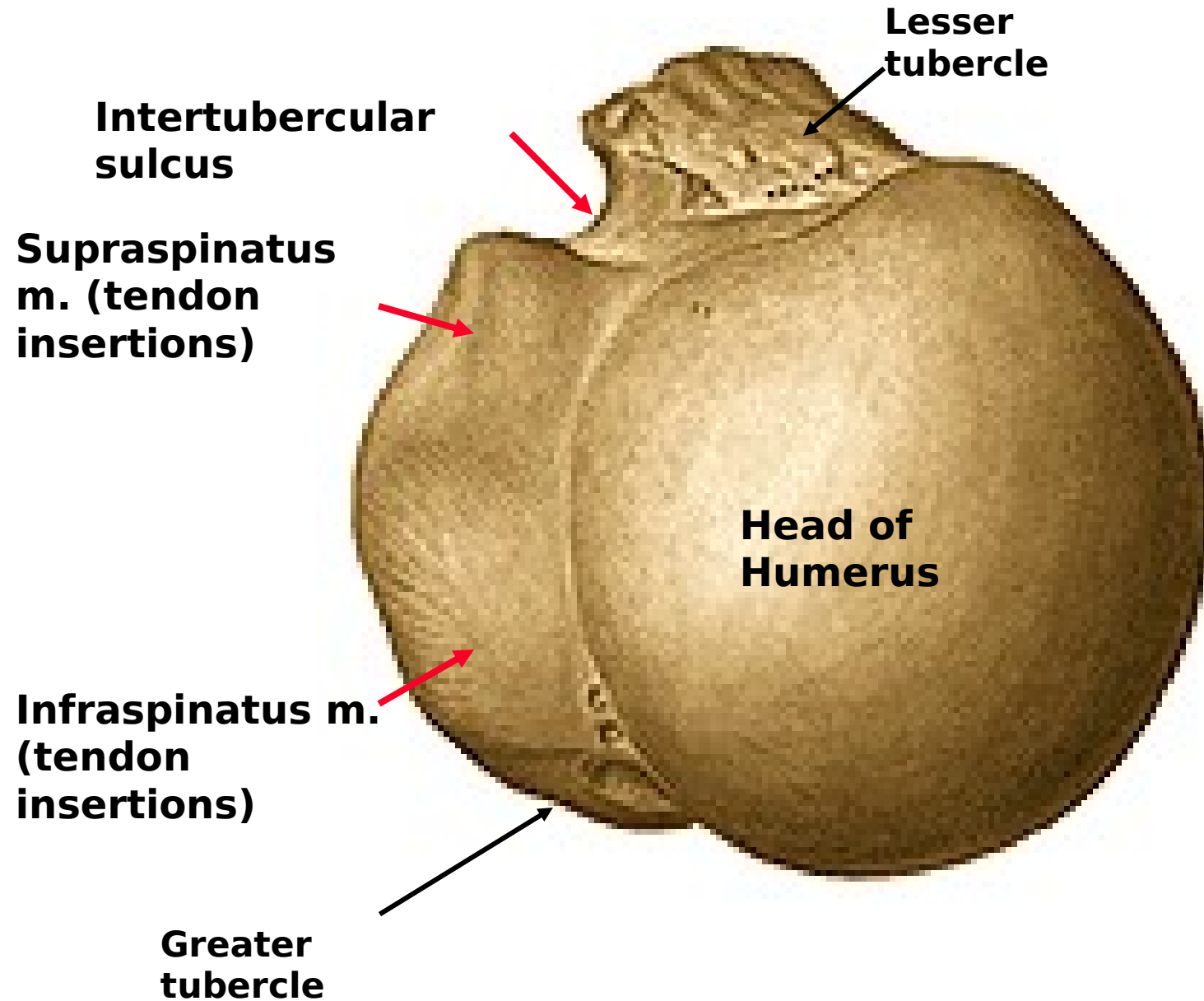


**lateral  
epicondyle**

**medial  
epicondyle**

**capitulum**

**trochlea**



Epiphyses of head and  
tubercles blend at fifth  
year, and unite with  
body at twentieth  
year



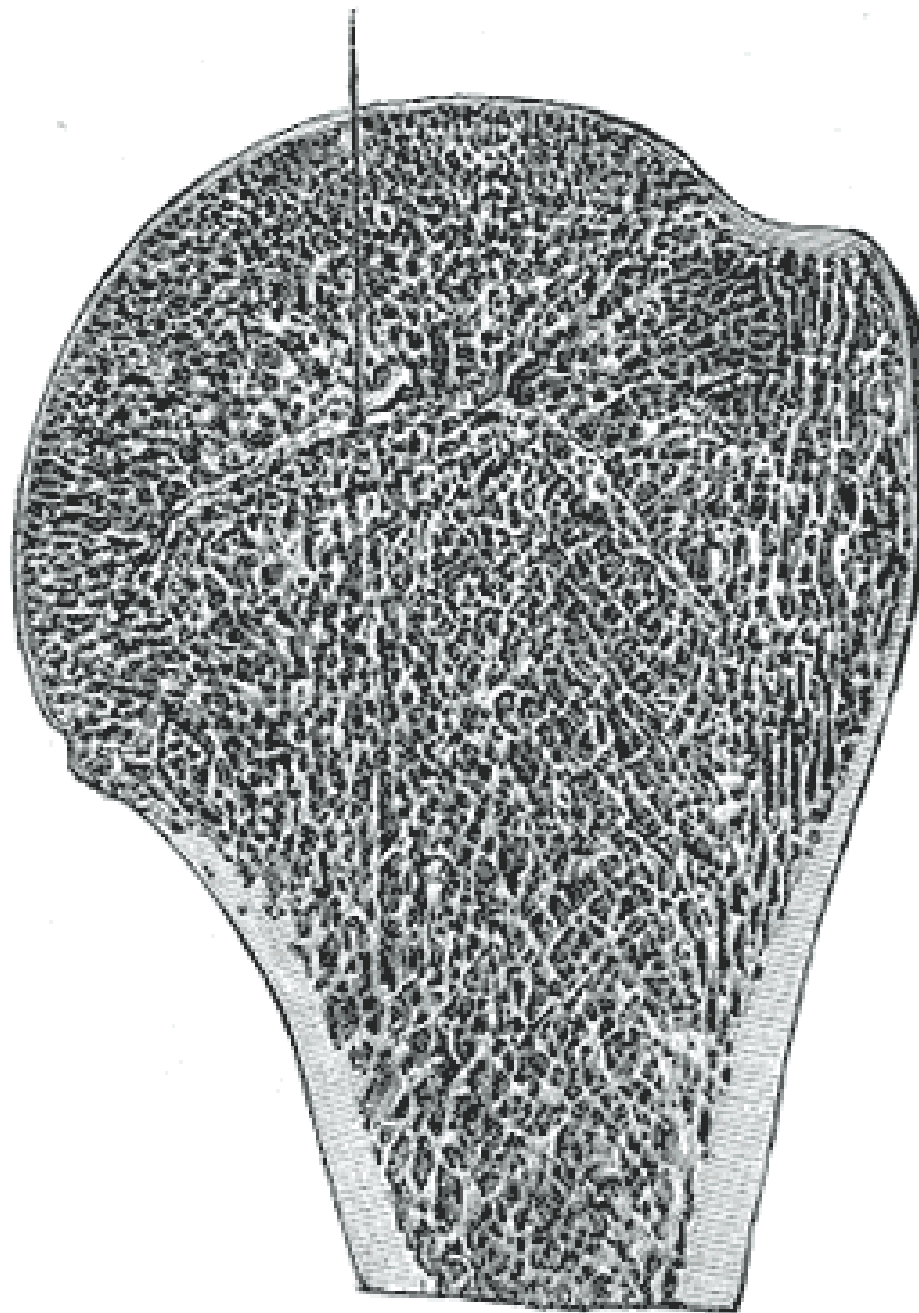
1.  
Body  
8 yr 10 yr

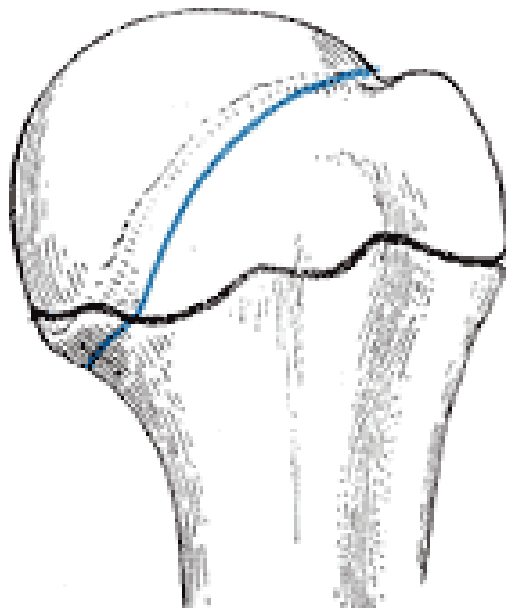
Unites with body  
at eighteenth year



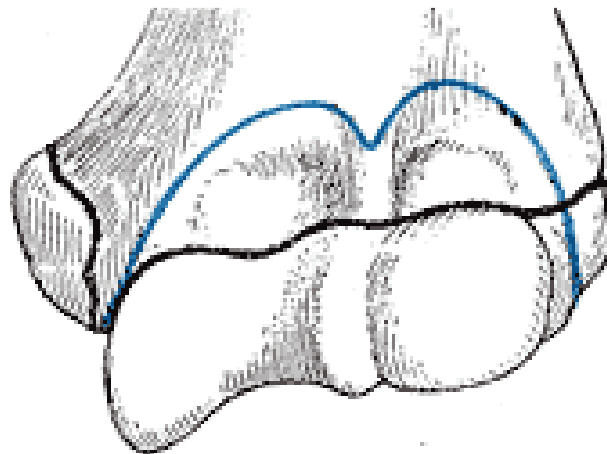
Blend and unite with  
Body at 16-17 yr

*Epiphysial line*



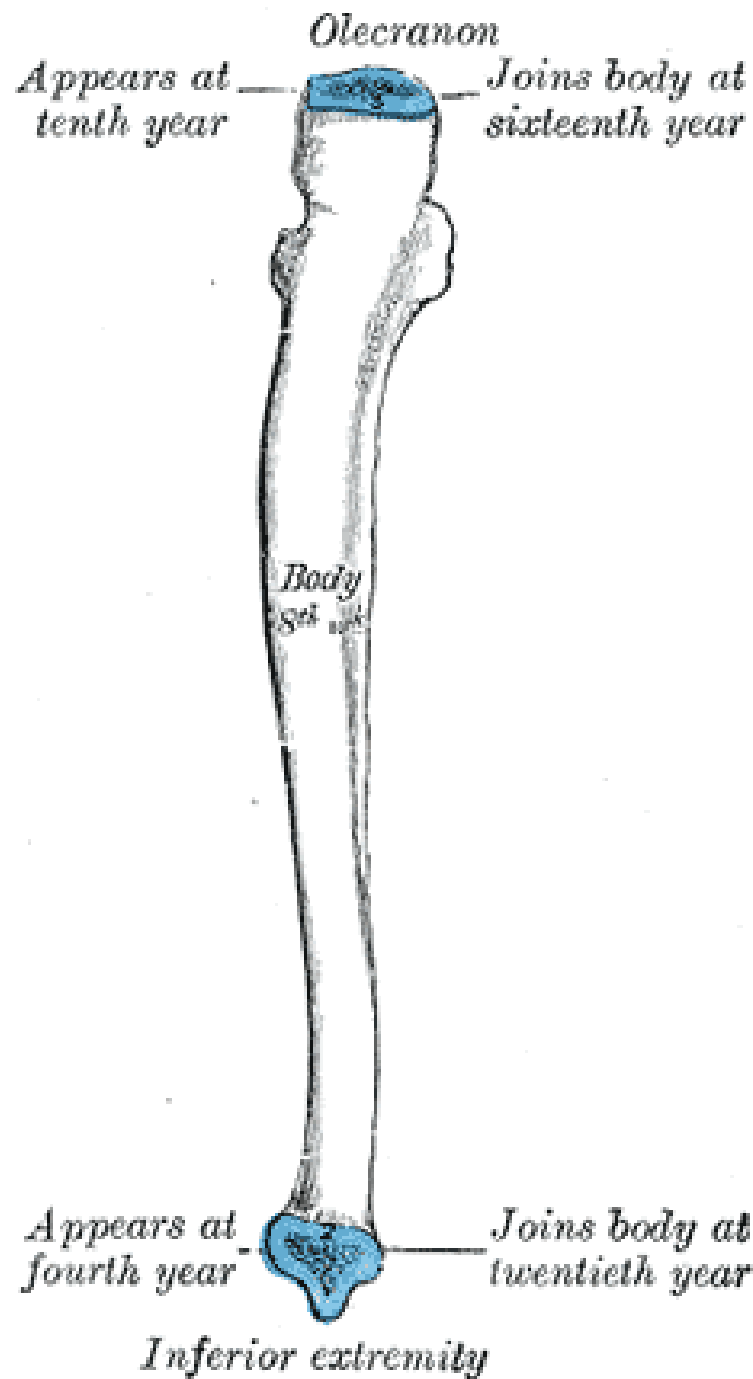


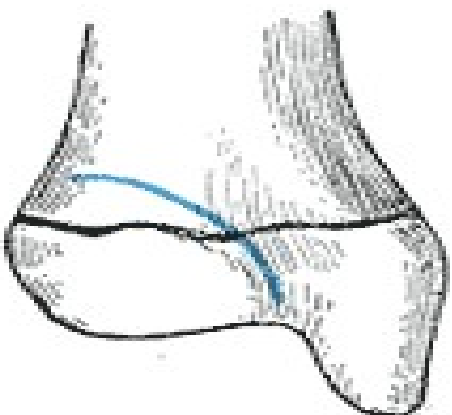
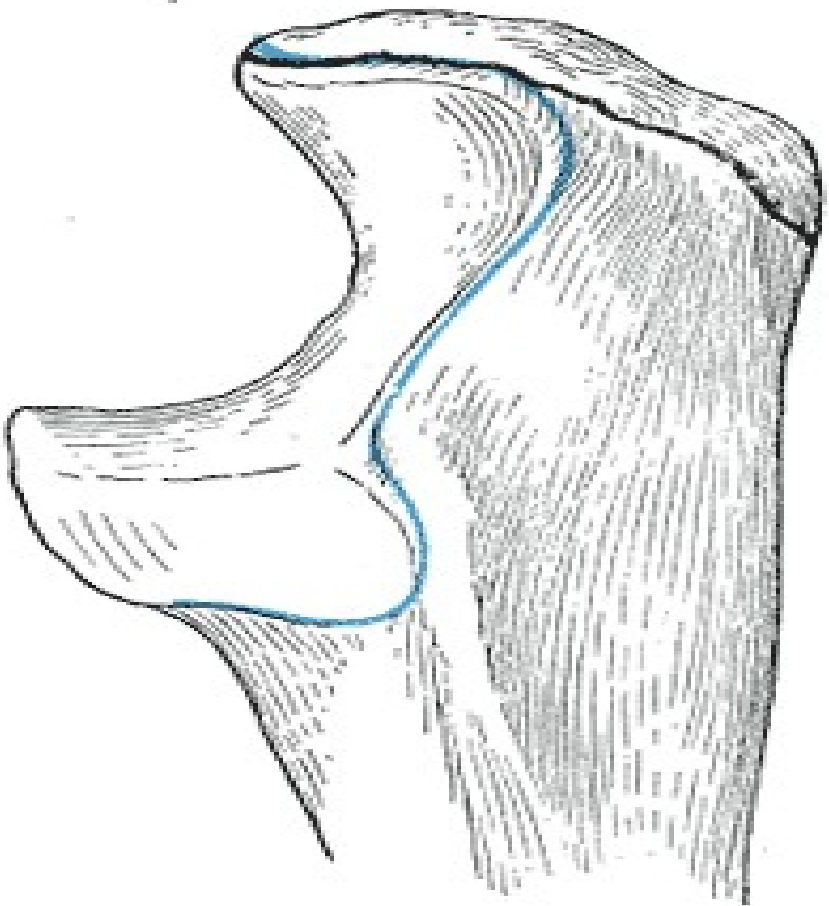
Epiphysial lines of humerus in a young adult.  
The lines of attachment of the articular capsules  
are in **blue**.

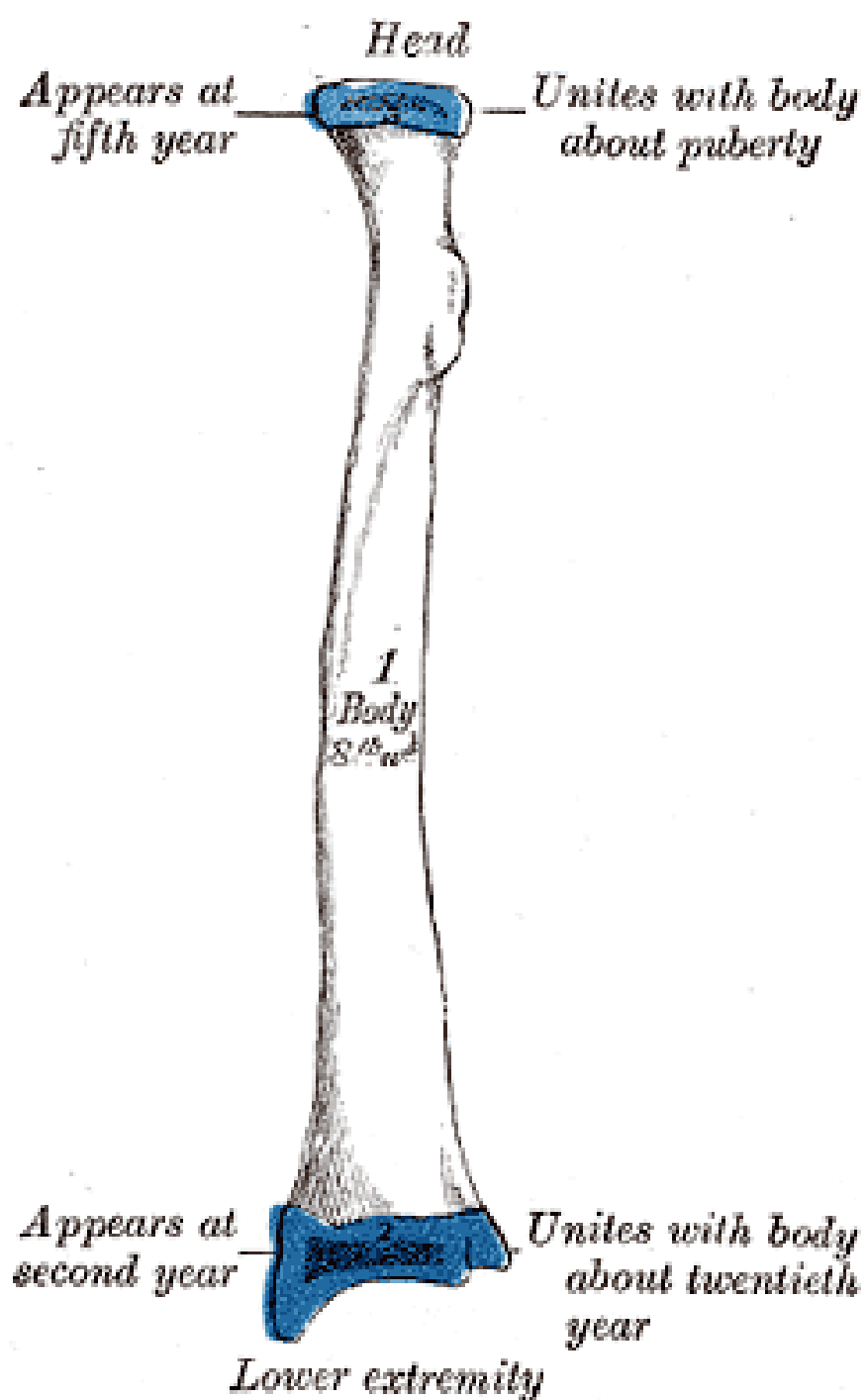


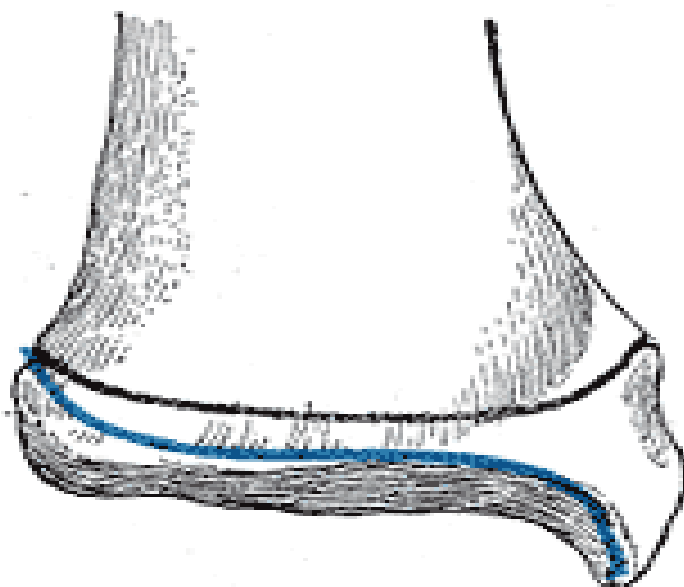
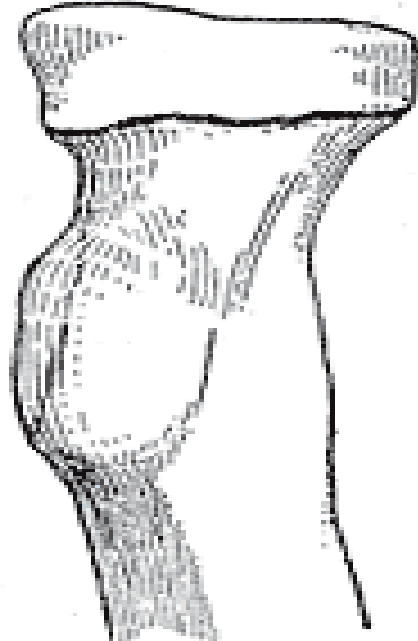
# RADIUS & ULNAR

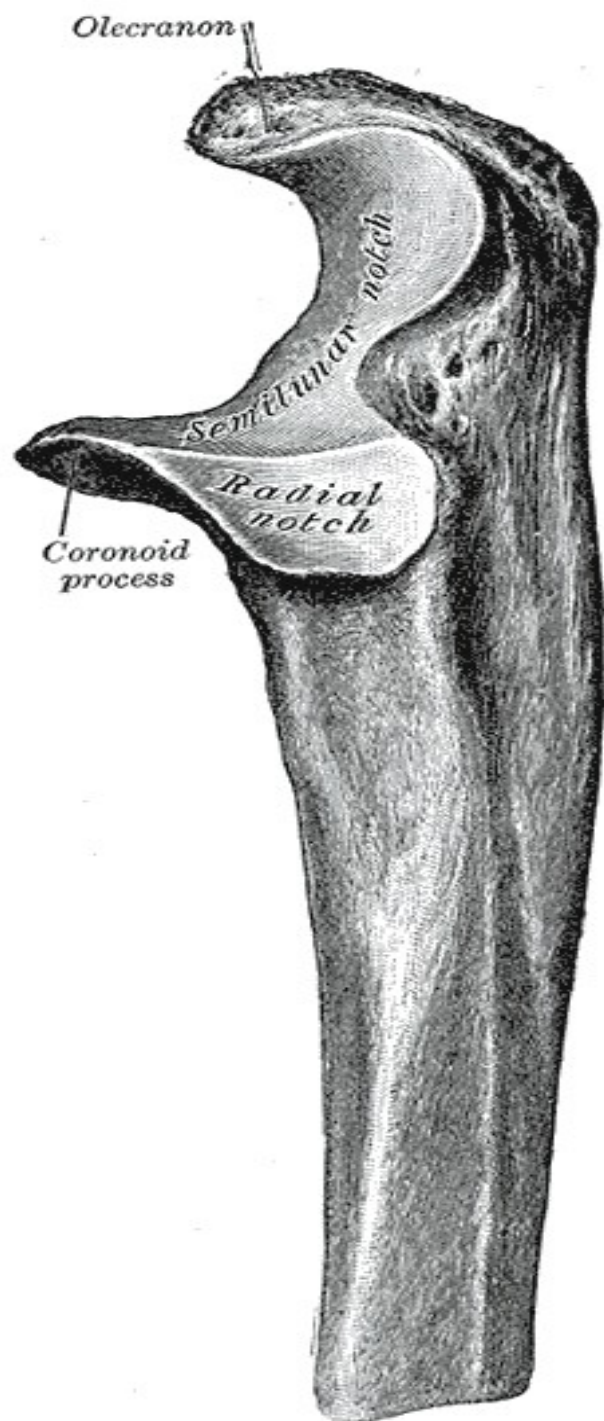


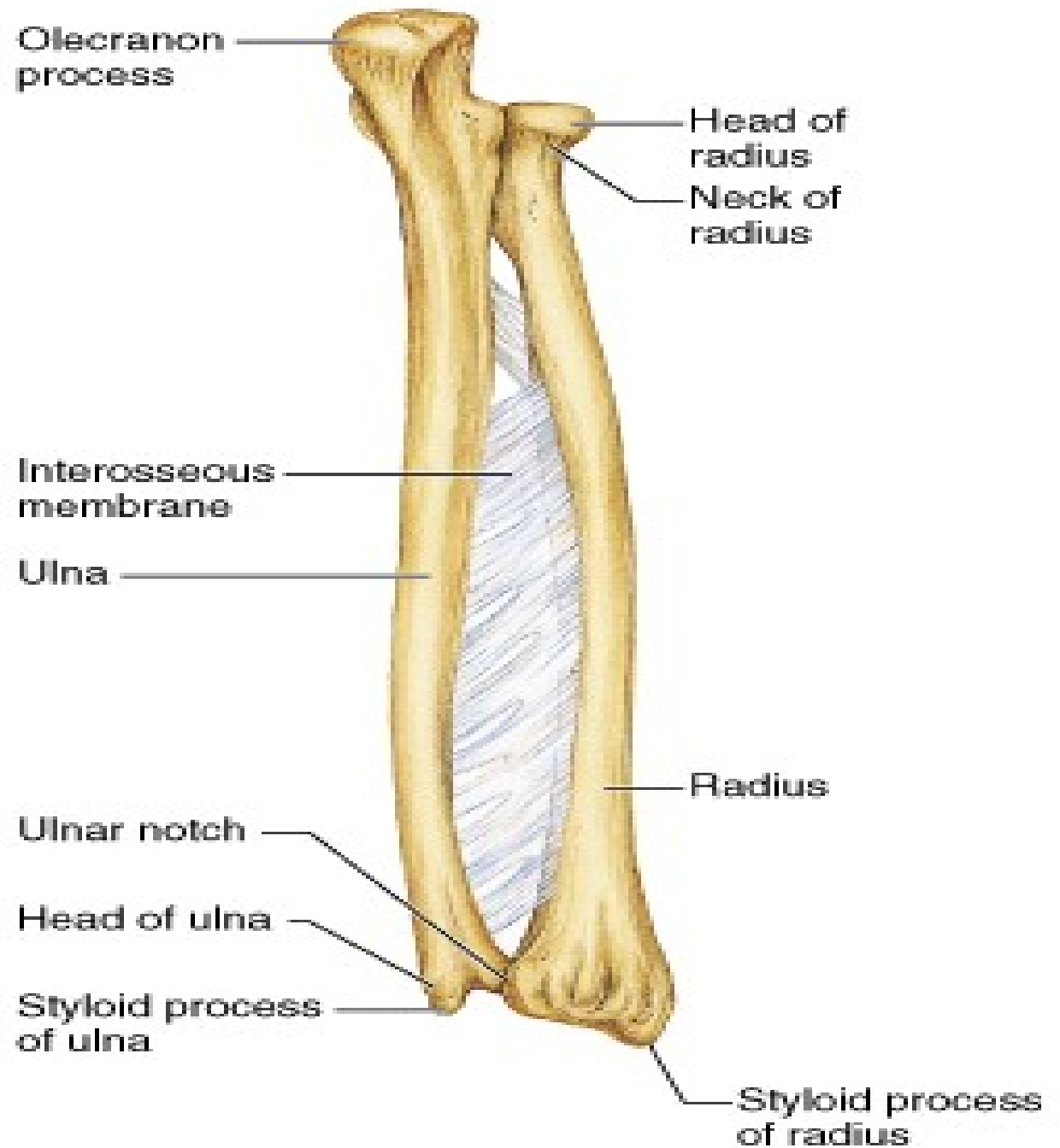
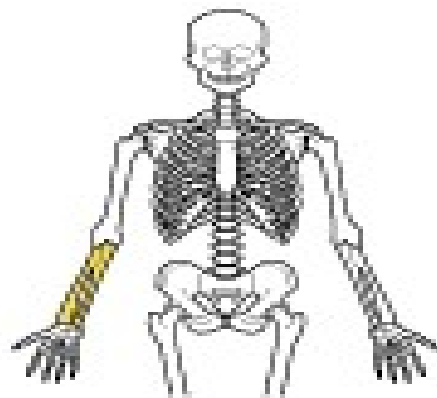




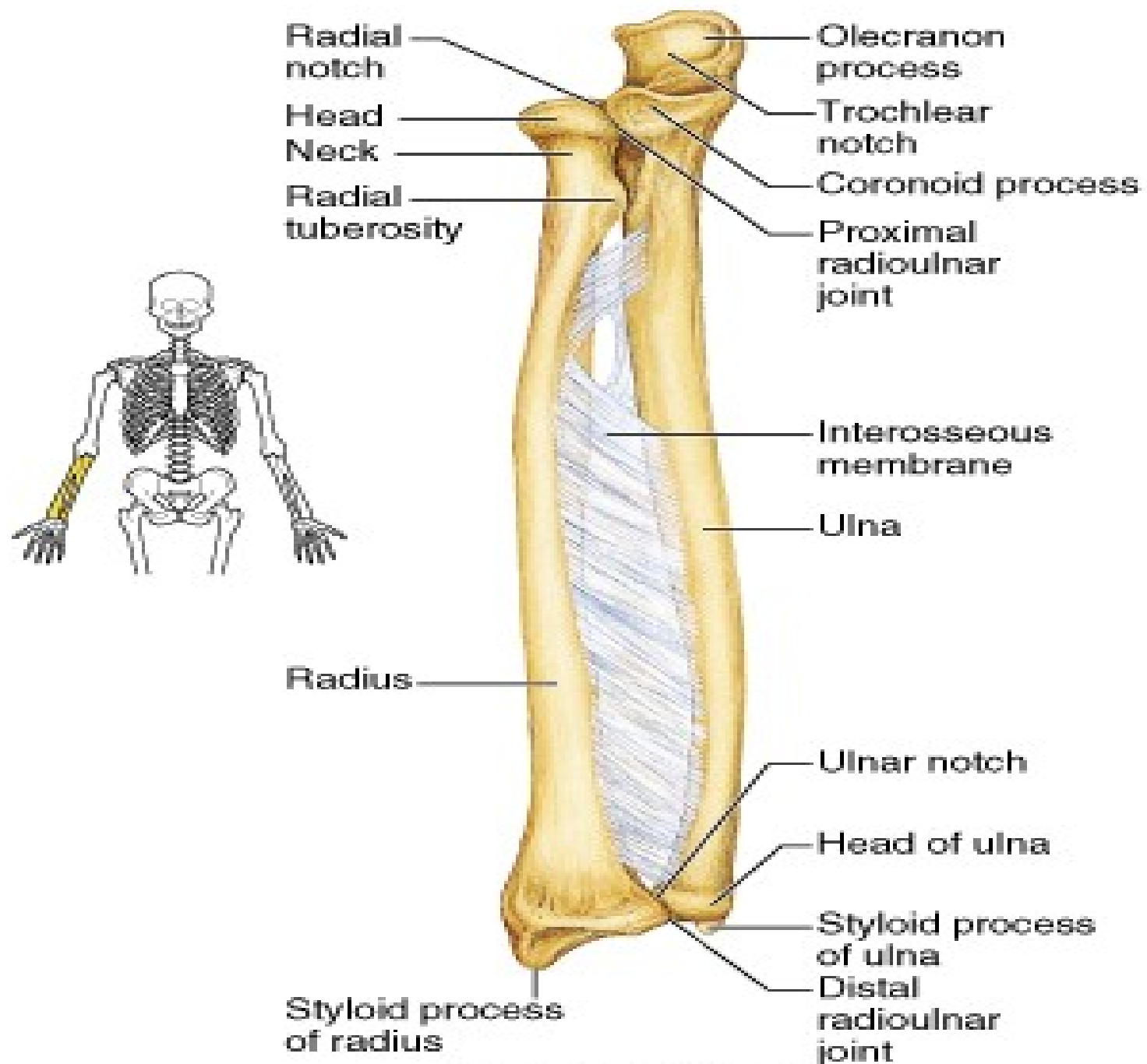




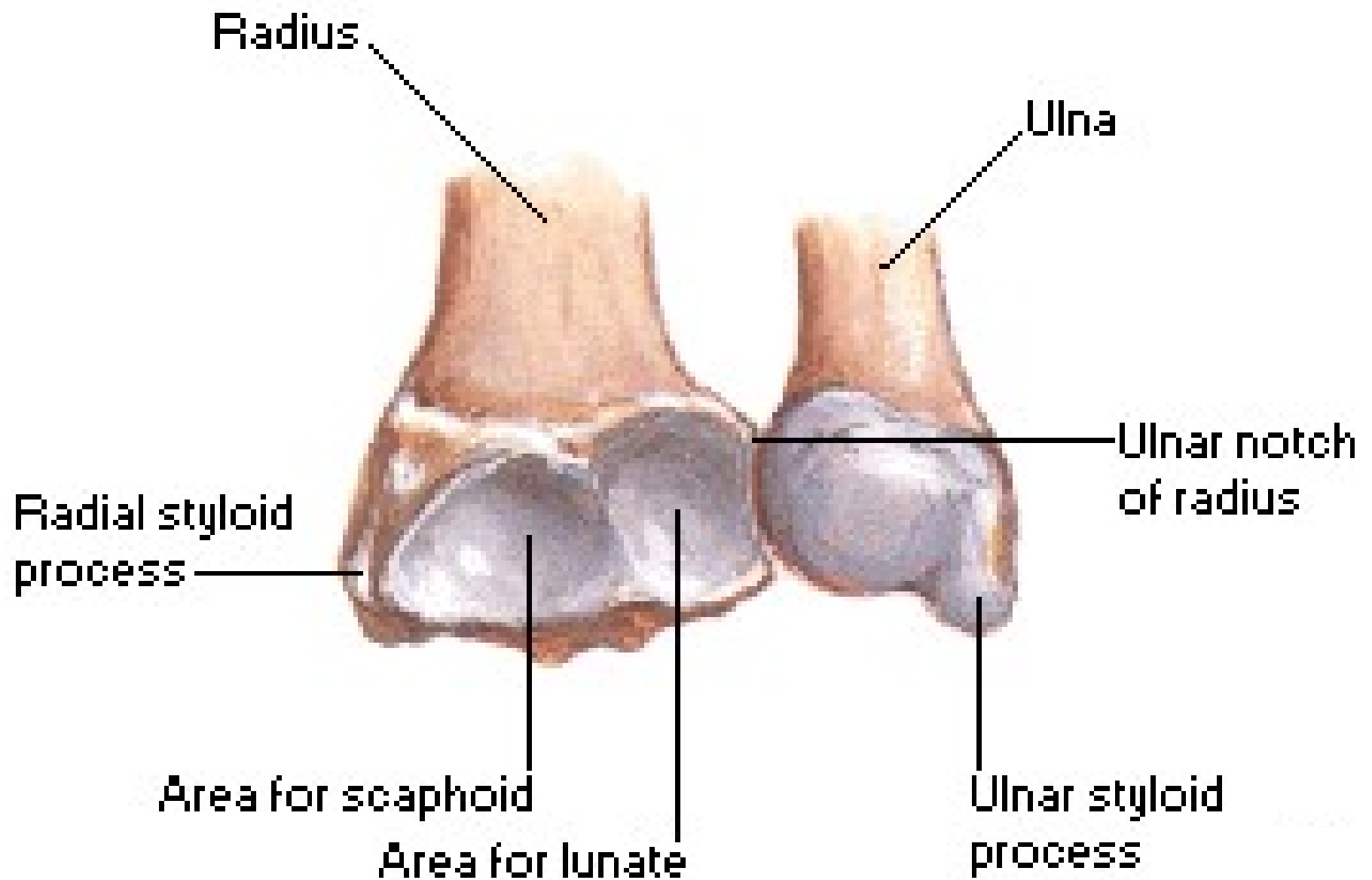




**(b) Posterior view**

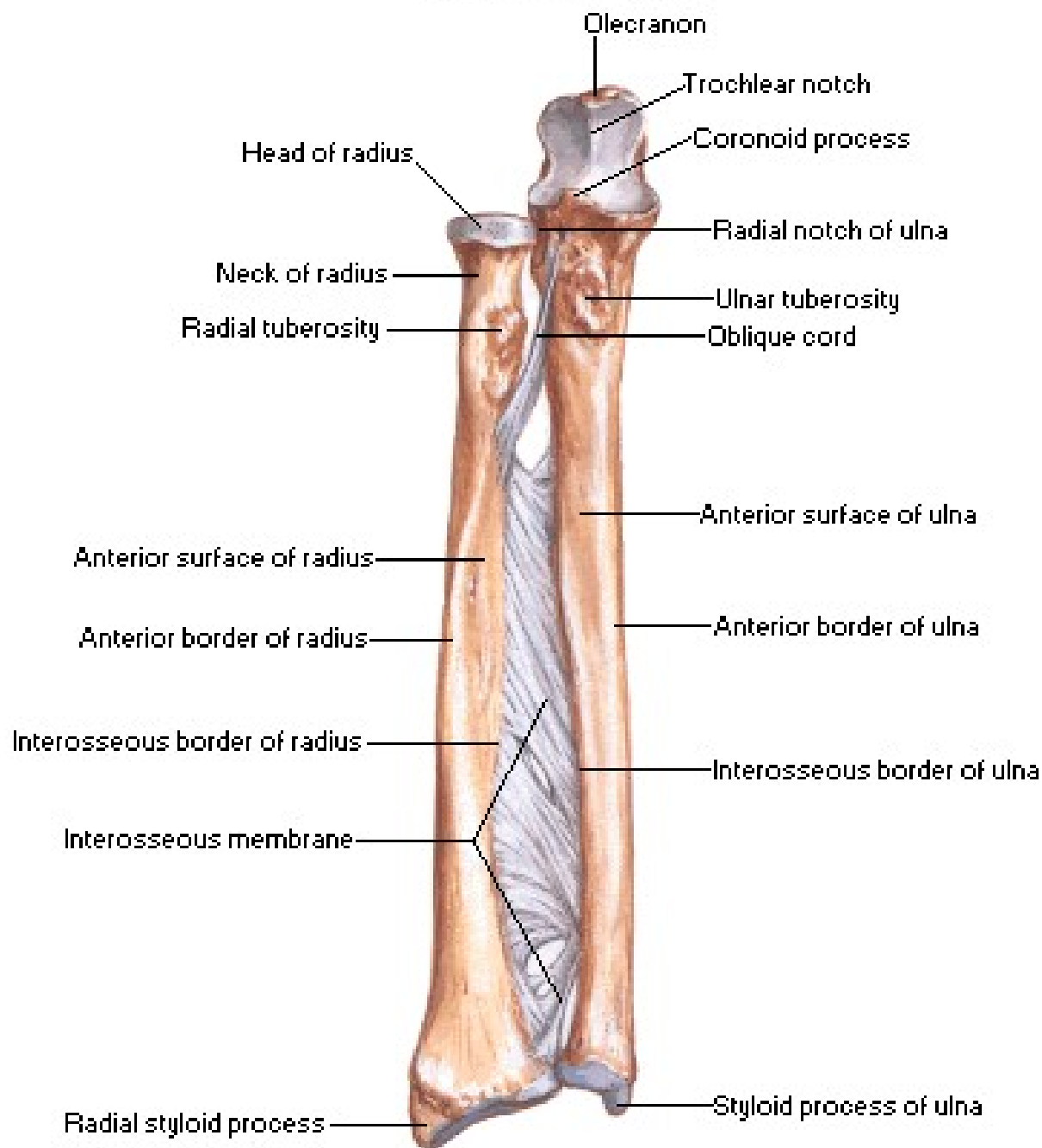


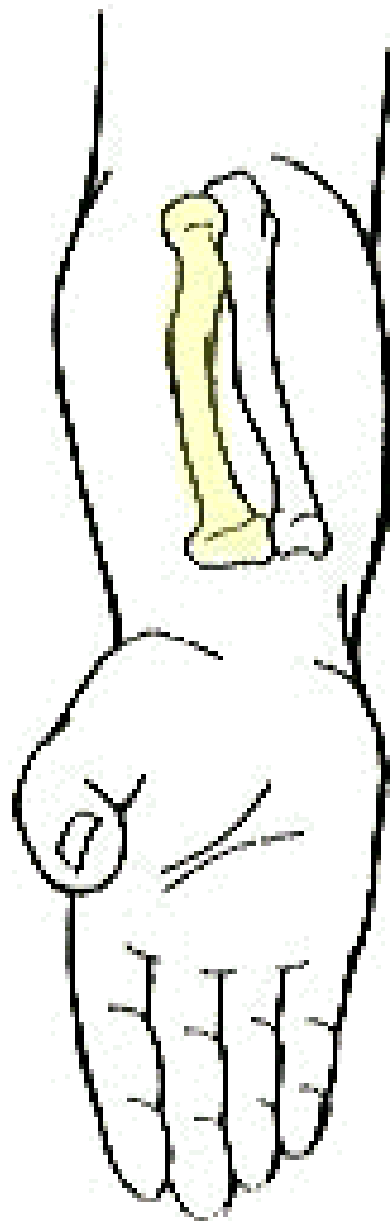
**(a) Anterior view**



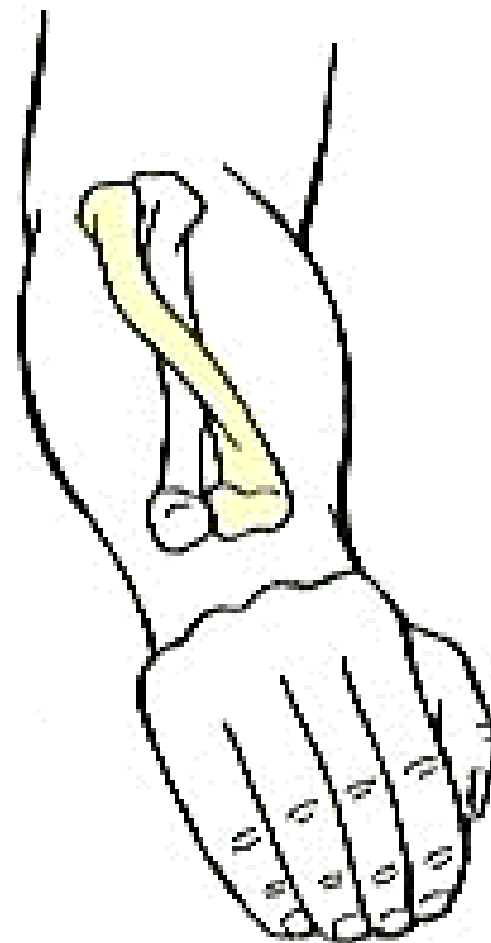


# Anterior View





**supination**



**pronation**

# WRIST & HAND

# Bone of the Wrist

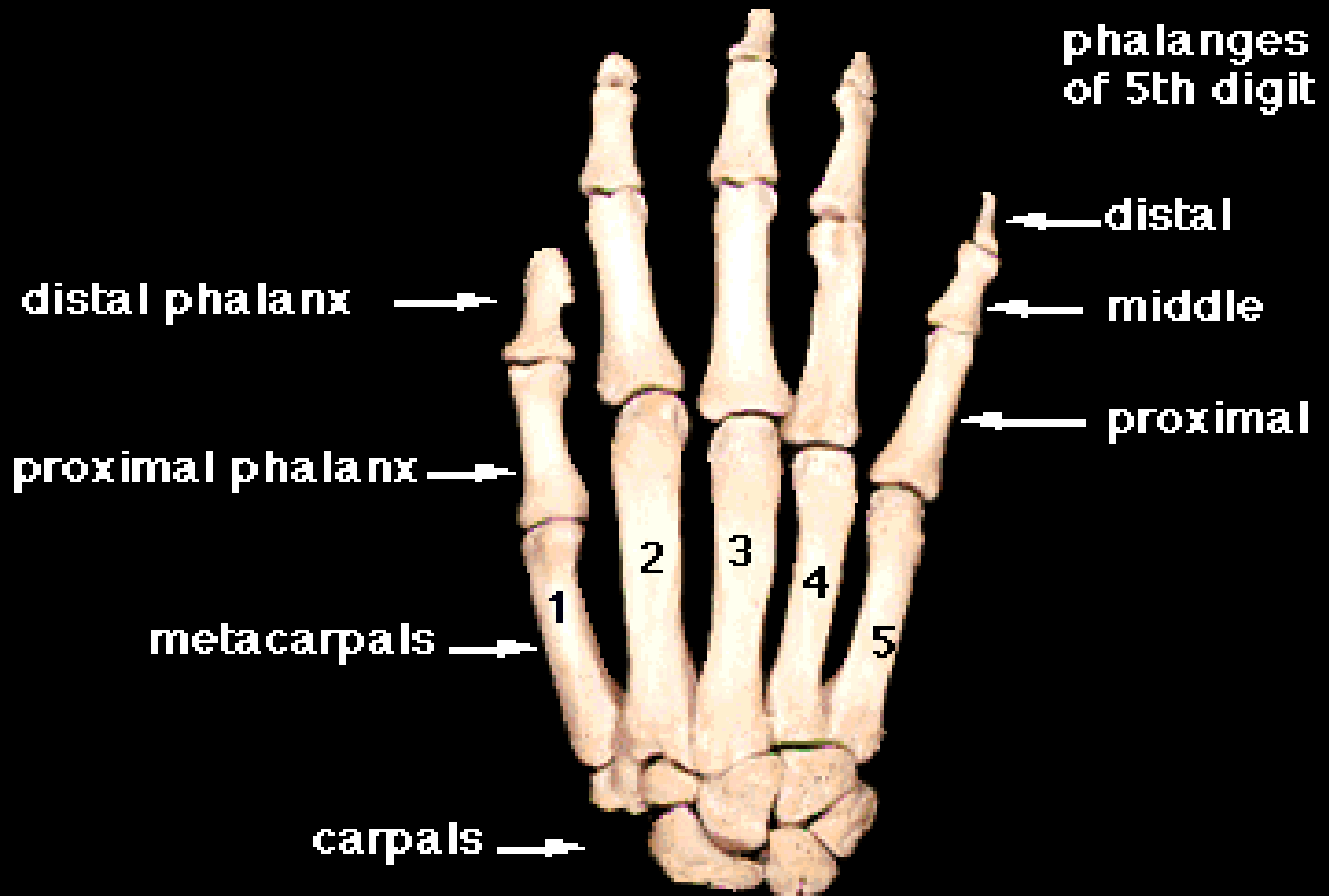
- Wrist = the carpal bones - 8
- 4 bones in the proximal row:
  - **Scaphoid** - boat-shaped & articulates with radius & has prominent tubercle
  - **Lunate** - moon-shaped & articulates with radius

# Bone of the Wrist

- 4 bones in the proximal row:
  - **Triquetrum** - 3 cornered pyramidal & articulates with articular disc or the distal radioulnar joint
  - **Pisiform** - small, pea-shaped on the palmar surface of the triquetrum.

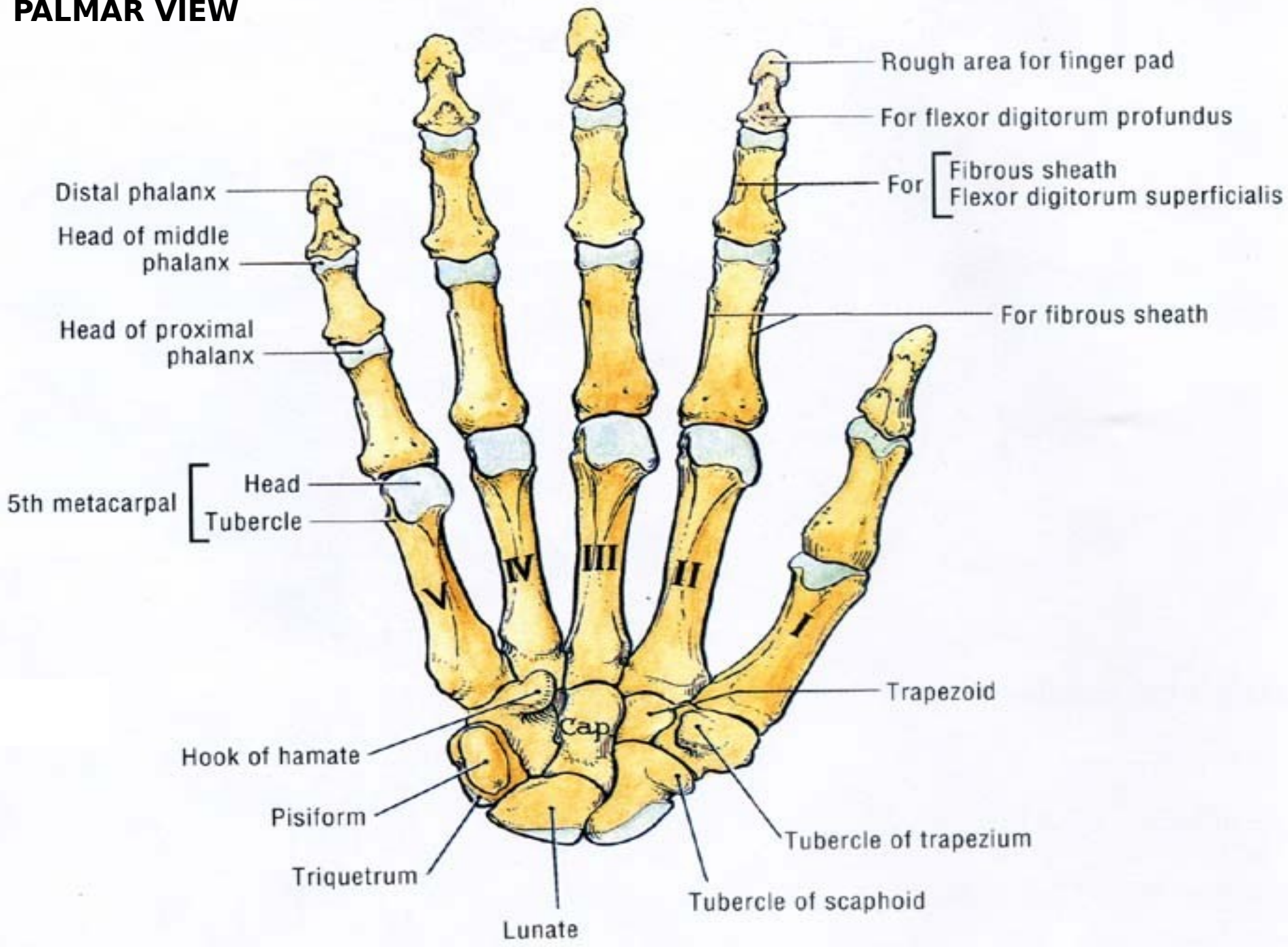
# Bone of the Wrist

- 4 bones in the distal row:
  - Trapezium - 4 sided
  - Trapezoid - wedge shaped
  - Capitate - rounded head
  - Hamate - wedge-shaped & has a hooked process, the *hook of the hamate*



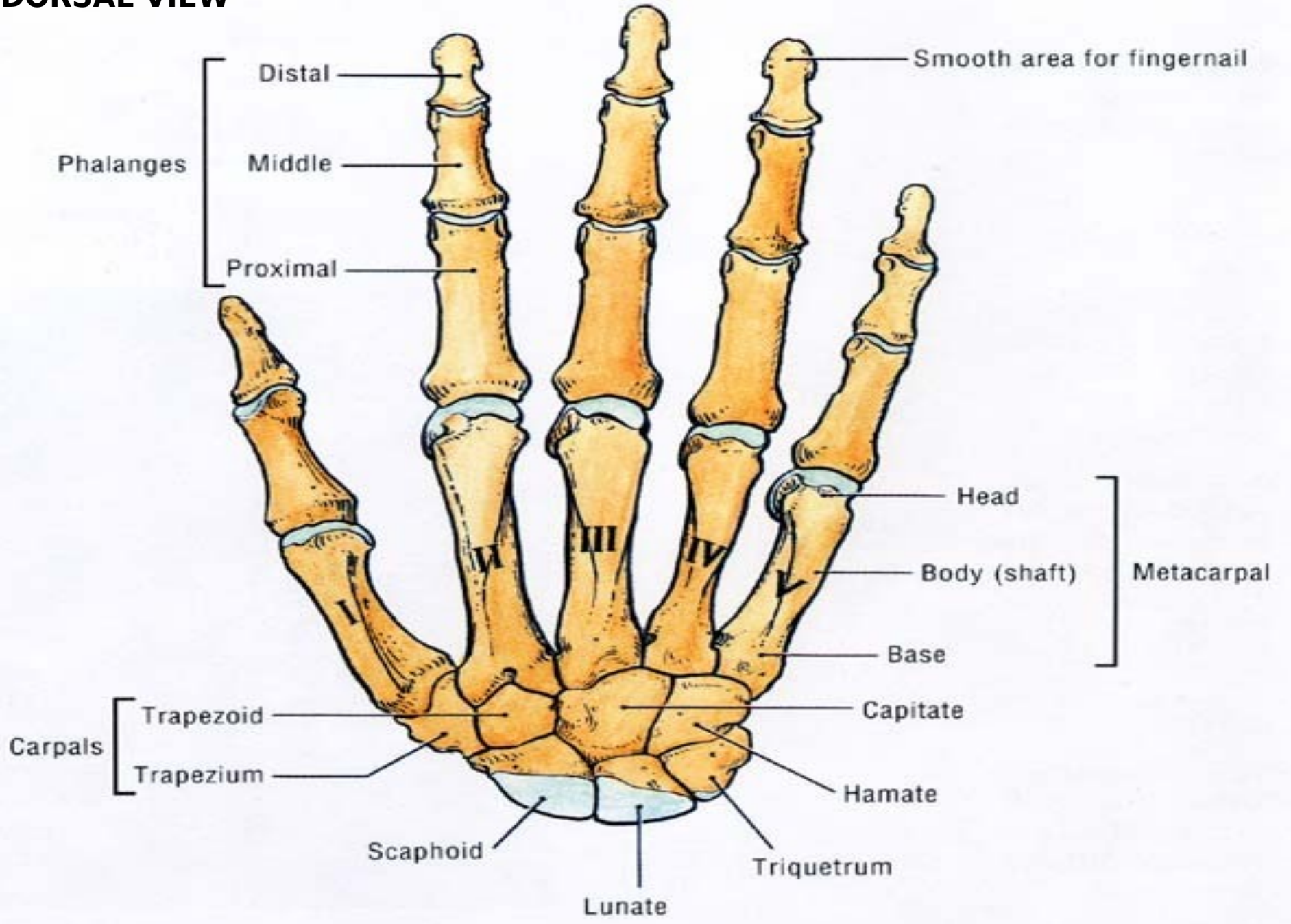
Posterior View - right hand

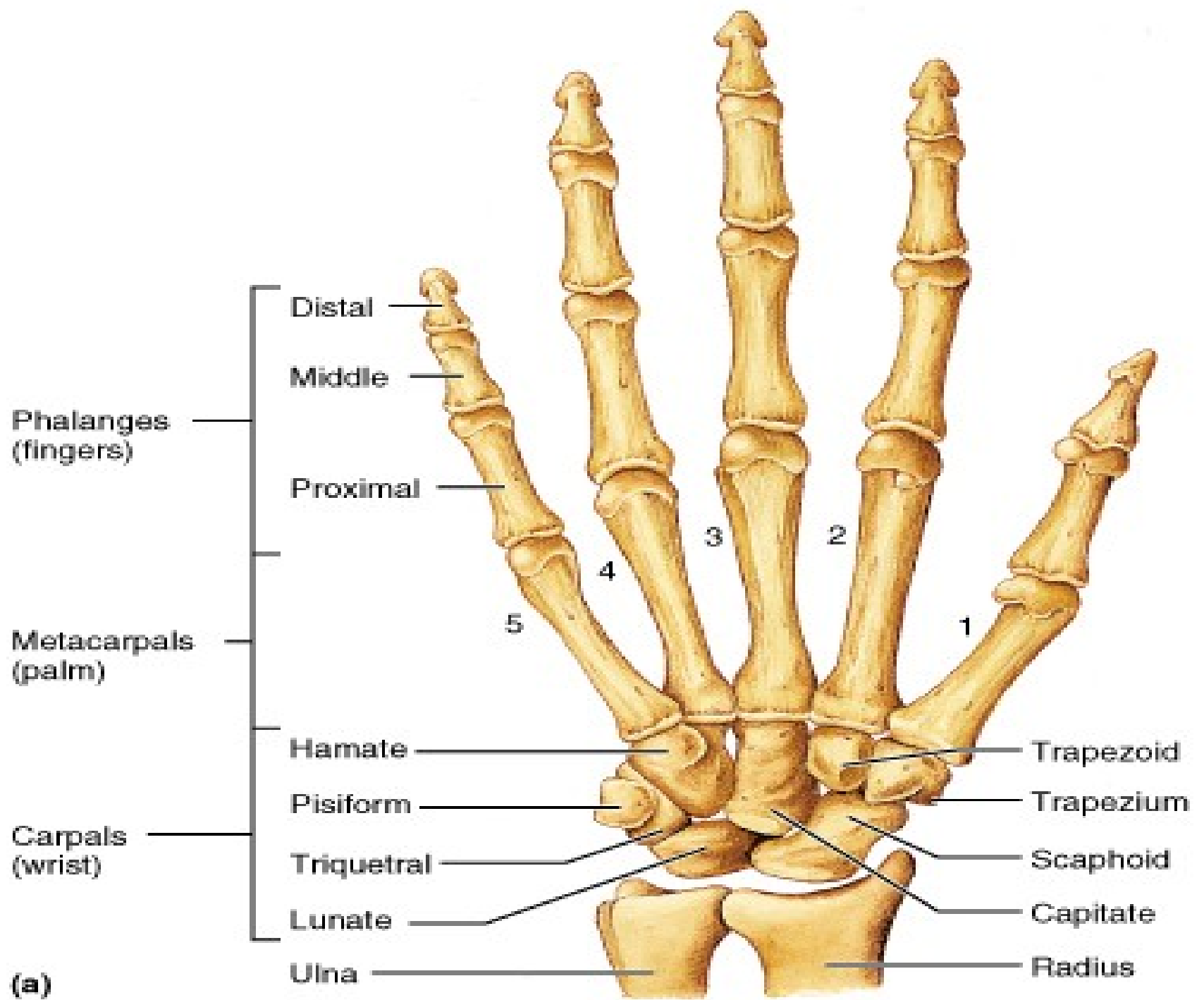
**PALMAR VIEW**





**DORSAL VIEW**



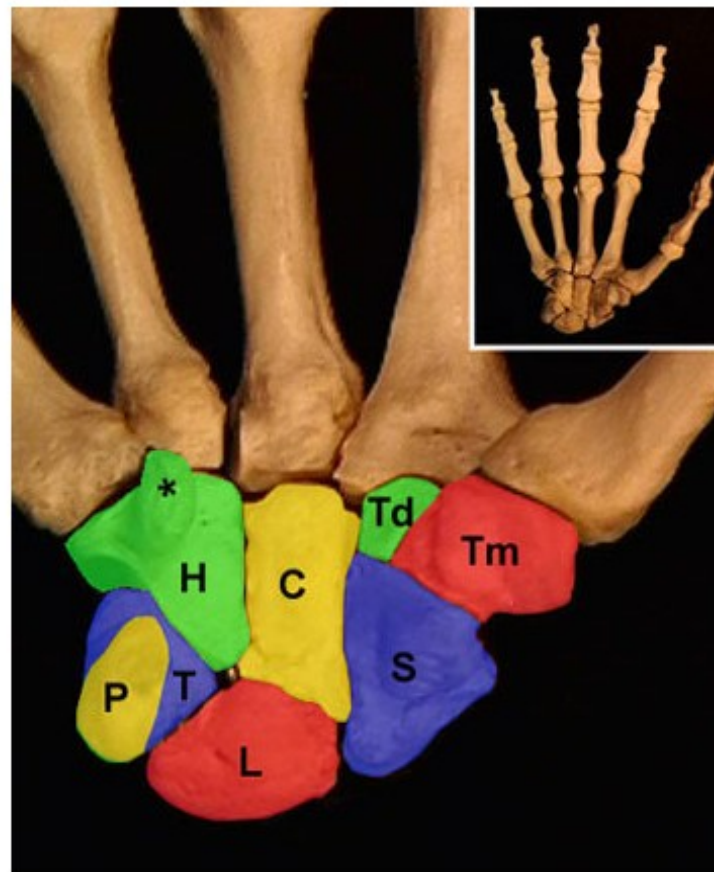


## Surface Anatomy: Carpal Bones (Right)

Dorsal view



Palmar view



*Carpal bones:*

**S. Scaphoid**

**L. Lunate**

**T. Triquetrum**

**P. Pisiform**

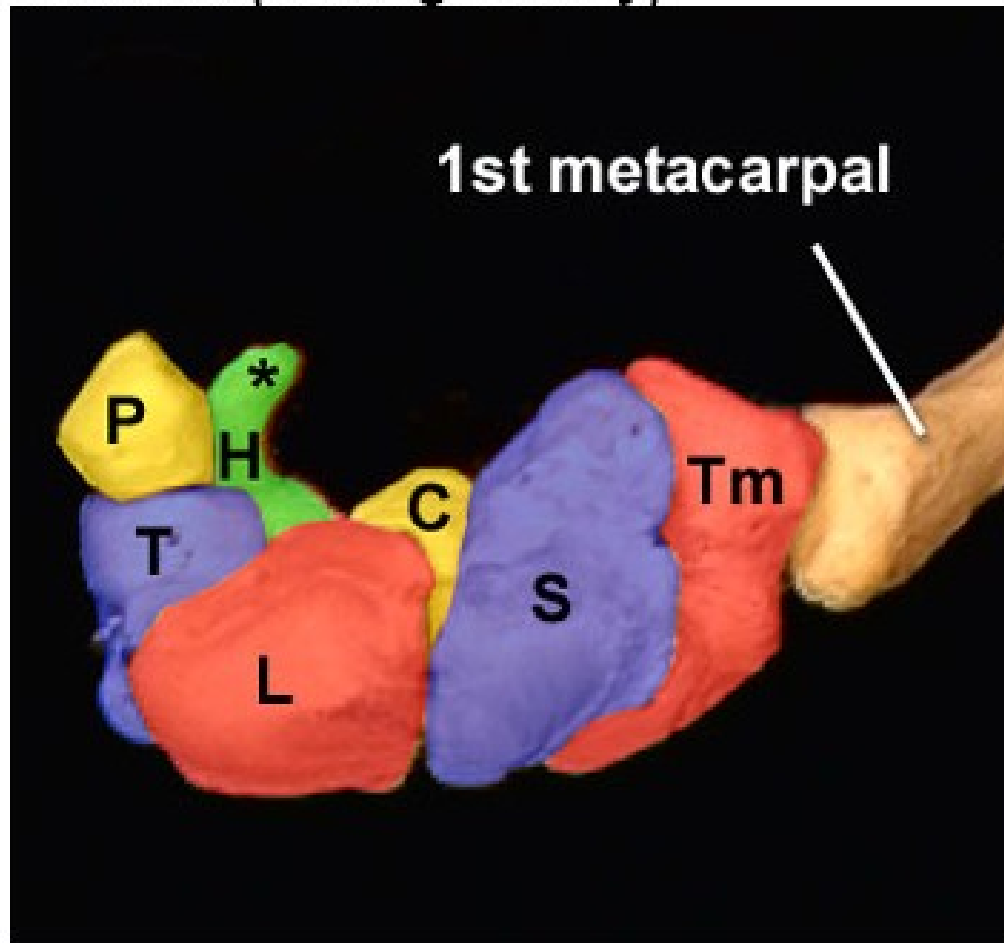
**Tm. Trapezium**

**Td. Trapezoid**

**C. Capitate**

**H. Hamate (\*=hook)**

**Proximal (looking Distally)**



***Carpal bones:***

**S. Scaphoid**

**L. Lunate**

**T. Triquetrum**

**P. Pisiform**

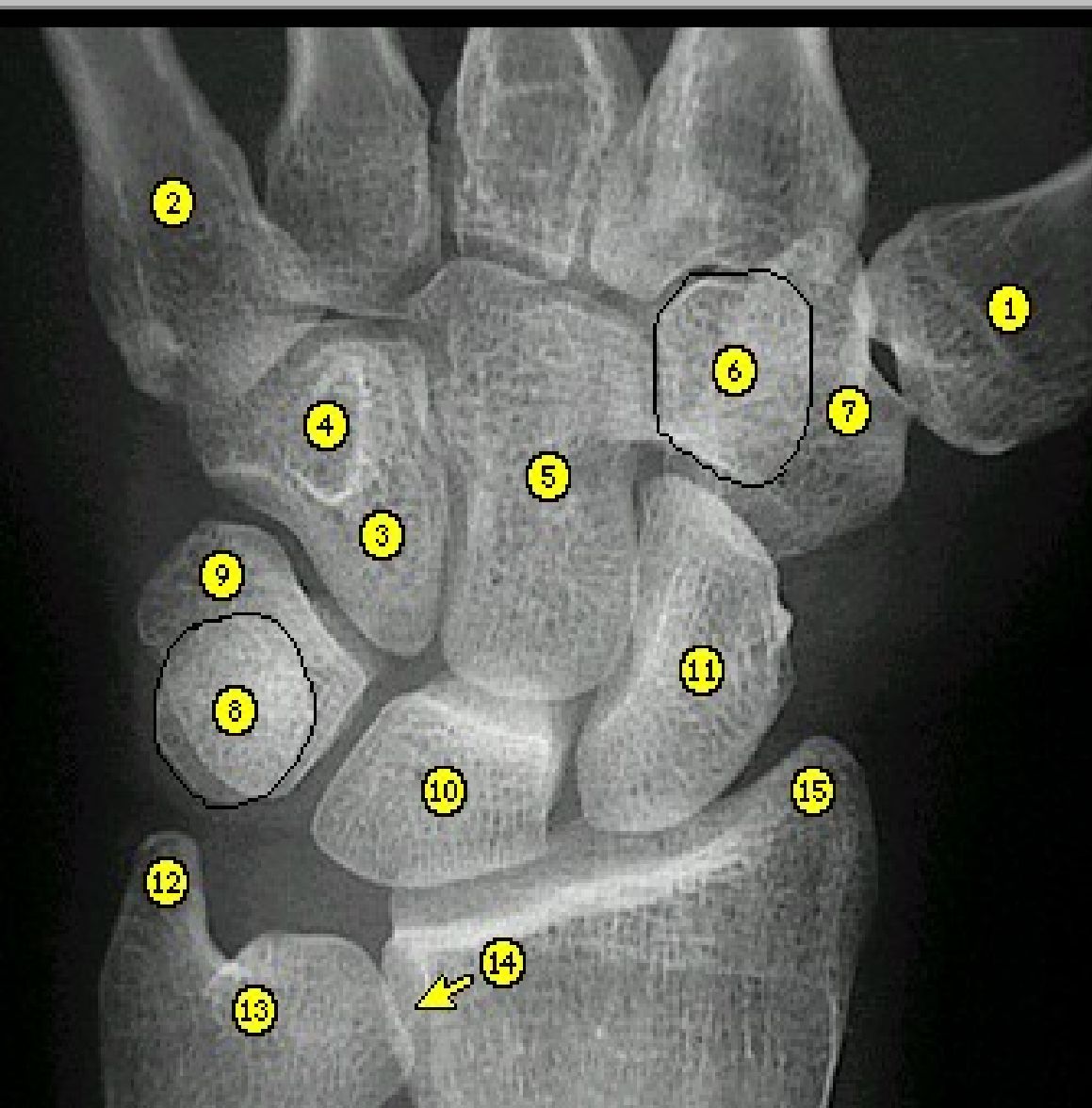
**Tm. Trapezium**

**Td. Trapezoid**

**C. Capitate**

**H. Hamate (\*=hook)**

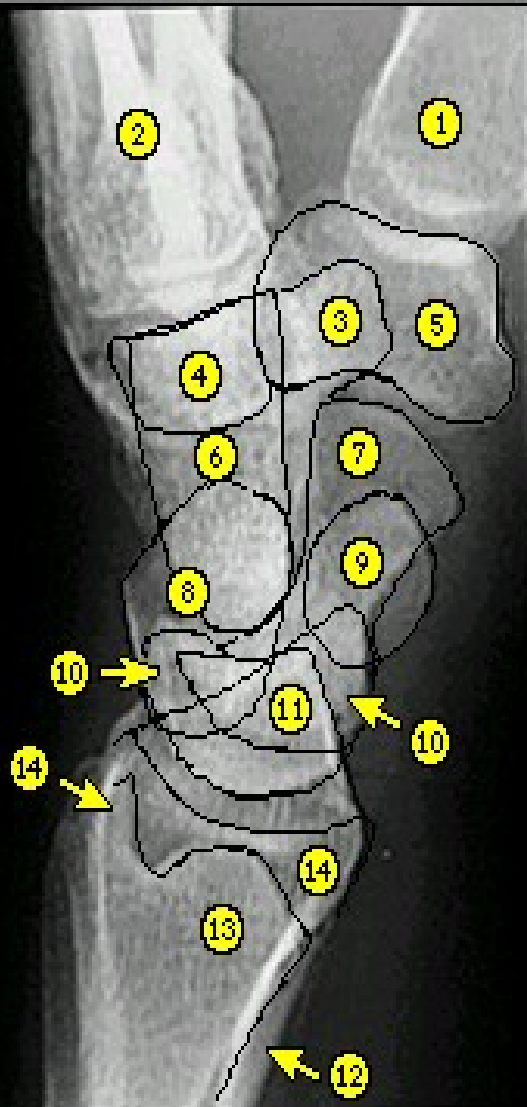
## PA Wrist



## Bones and Joints

- 1-1st metacarpal
- 2-5th metacarpal
- 3-body of hamate
- 4-hook of hamate
- 5-capitate
- 6-trapezoid
- 7-trapezium
- 8-pisiform
- 9-triquetrum
- 10-lunate
- 11-scaphoid
- 12-ulnar styloid
- 13-ulnar head
- 14-ulnar notch of radius
- 15-radial styloid

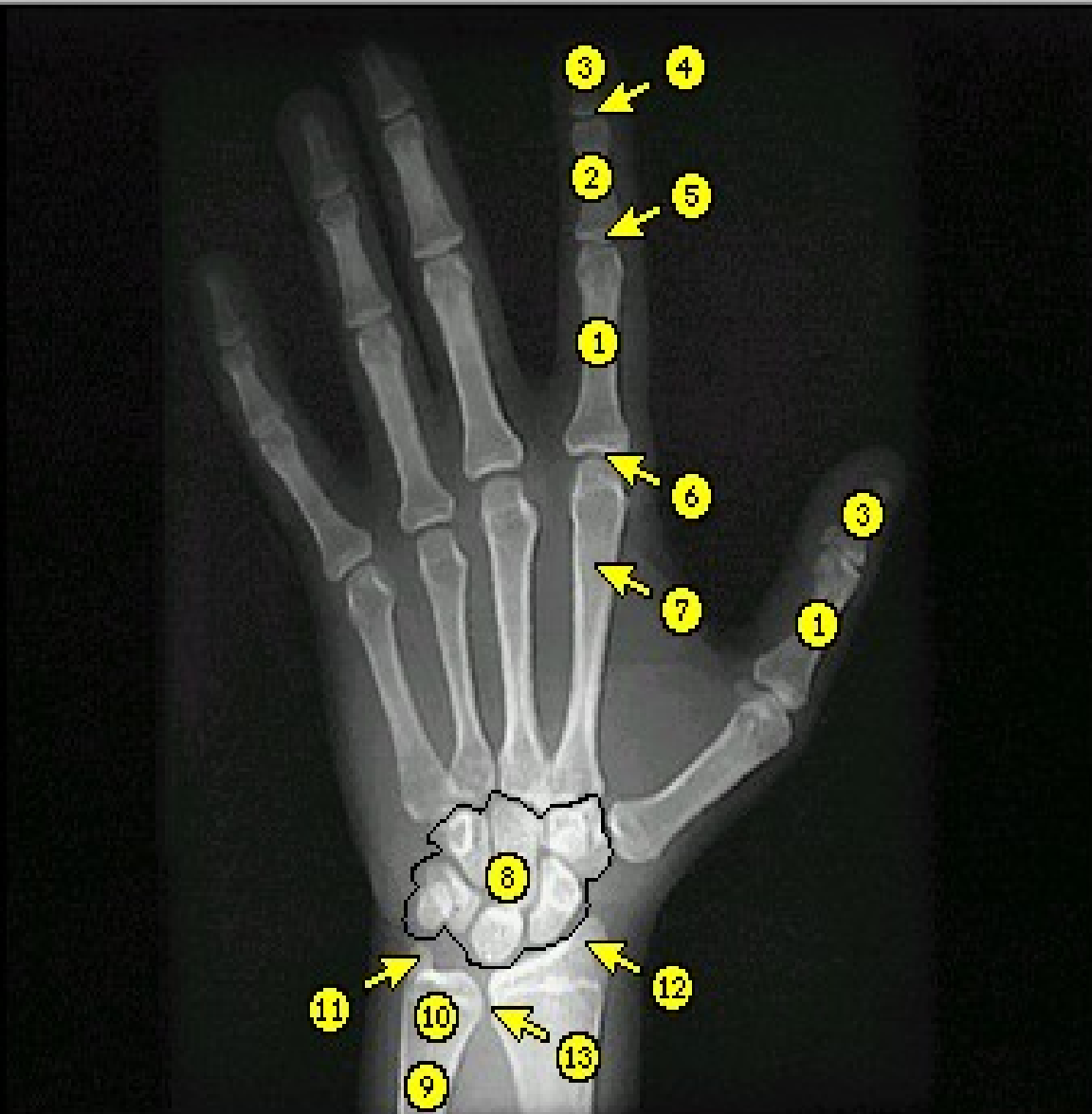
## Lateral Wrist



## Bones and Joints

- 1-1st metacarpal
- 2-2nd, 3rd, 4th, and 5th metacarpals
- 3-hook of hamate
- 4-trapezoid
- 5-trapezium
- 6-capitate
- 7-scaphoid
- 8-triquetrum
- 9-pisiform
- 10-lunate
- 11-radial styloid
- 12-shaft of radius
- 13-ulnar head
- 14-ulnar styloid

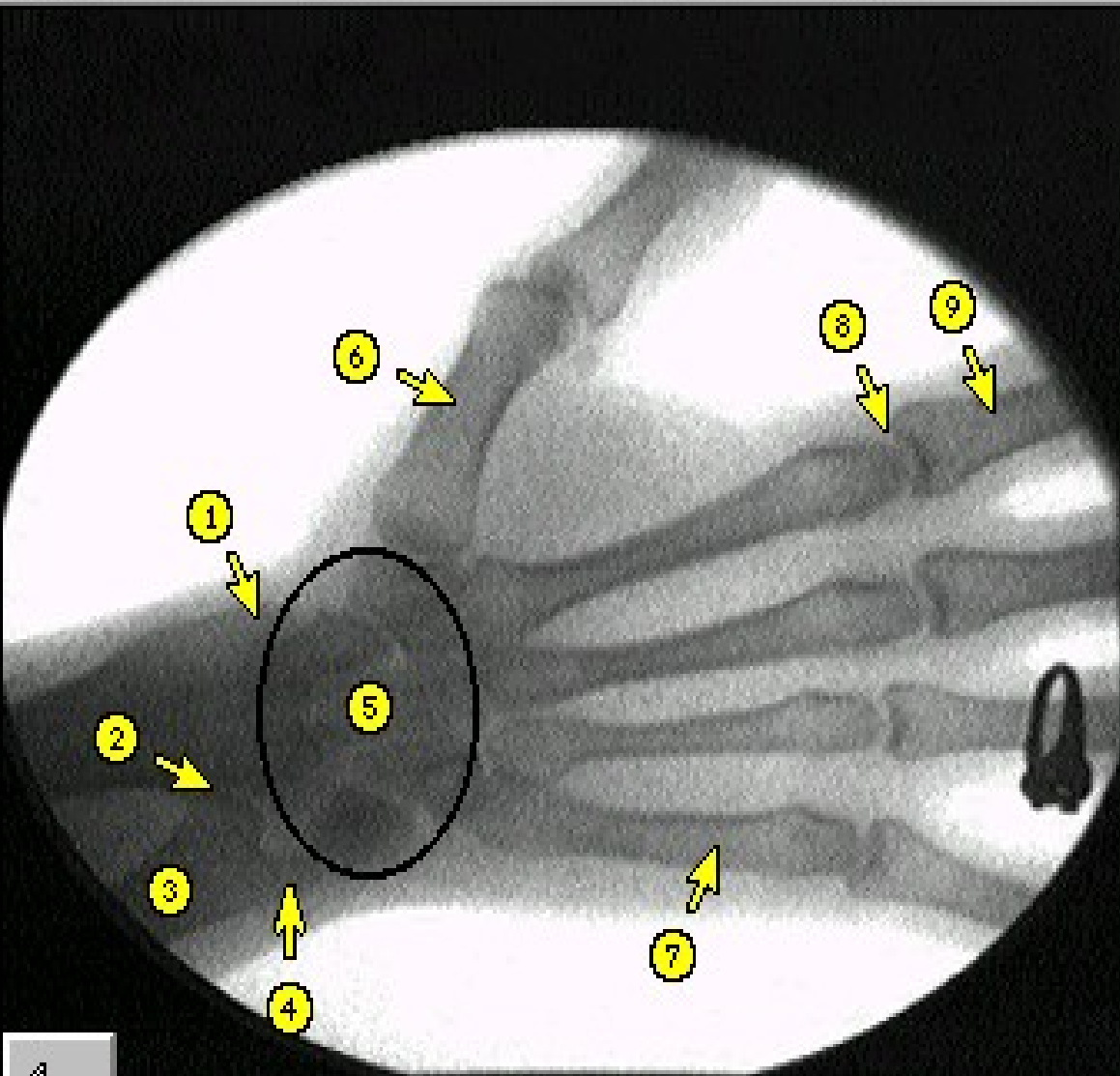
## PA Wrist and Hand



## Bones and Joints

- 1-proximal phalanx
- 2-middle phalanx
- 3-distal phalanx
- 4-DIP joint
- 5-PIP joint
- 6-MP joint
- 7-2nd metacarpal
- 8-carpals
- 9-shaft of ulna
- 10-head of ulna
- 11-ulnar styloid
- 12-radial styloid
- 13-ulnar notch of radius

## Fluoroscopy, Wrist and Hand



## Bones and Joints

- 1-radial styloid
- 2-ulnar notch of radius
- 3-shaft of ulna
- 4-ulnar styloid
- 5-carpals
- 6-1st metacarpal
- 7-5th metacarpal
- 8-MP joint
- 9-proximal phalanx

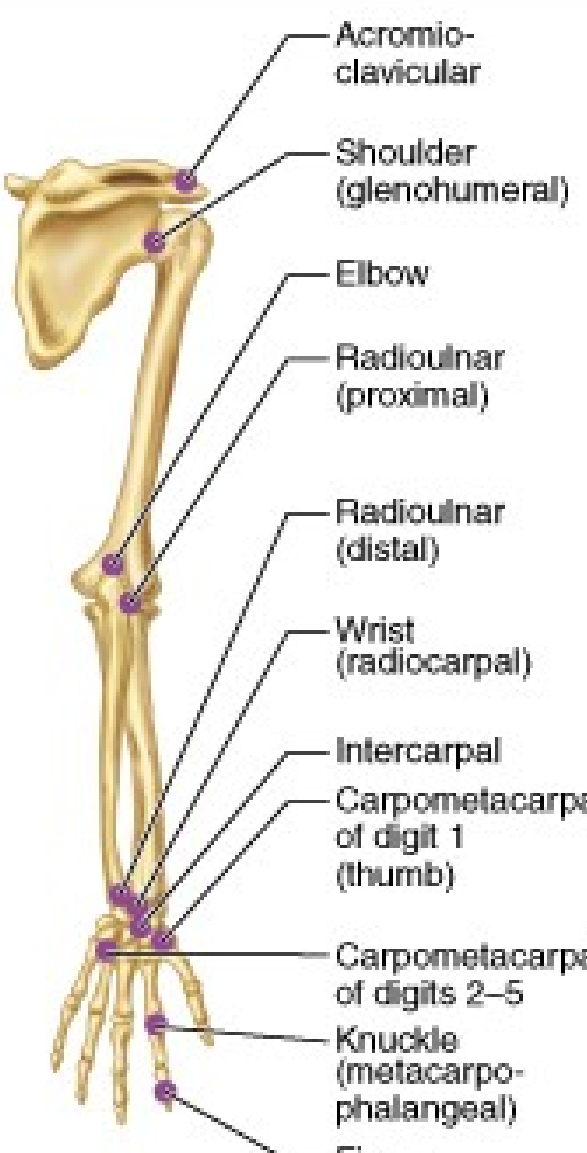




# JOINTS OF THE UPPER LIMB

TABLE 8.2

Structural and Functional Characteristics of Body Joints

<i>Illustration</i>	<i>Joint</i>	<i>Articulating bones</i>	<i>Structural type*</i>	<i>Functional type; movements allowed</i>
	Acromio-clavicular	Acromion of scapula and clavicle	Synovial; plane	Diarthrotic; gliding and rotation of scapula on clavicle
	Shoulder (glenohumeral)	Scapula and humerus	Synovial; ball and socket	Diarthrotic; multiaxial; flexion, extension, abduction, adduction, circumduction, rotation of humerus
	Elbow	Ulna (and radius) with humerus	Synovial; hinge	Diarthrotic; uniaxial; flexion, extension of forearm
	Radioulnar (proximal)	Radius and ulna	Synovial; pivot	Diarthrotic; uniaxial; rotation of radius around long axis of forearm to allow pronation and supination
	Radioulnar (distal)	Radius and ulna	Synovial; pivot (contains articular disc)	Diarthrotic; uniaxial; rotation (convex head of ulna rotates in ulnar notch of radius)
	Wrist (radiocarpal)	Radius and proximal carpals	Synovial; condyloid	Diarthrotic; biaxial; flexion, extension, abduction, adduction, circumduction of hand
	Intercarpal	Adjacent carpals	Synovial; plane	Diarthrotic; gliding
	Carpometacarpal of digit 1 (thumb)	Carpal (trapezium) and metacarpal 1	Synovial; saddle	Diarthrotic; biaxial; flexion, extension, abduction, adduction, circumduction, opposition of metacarpal 1
	Carpometacarpal of digits 2–5	Carpal(s) and metacarpal(s)	Synovial; plane	Diarthrotic; gliding of metacarpals
	Knuckle (metacarpophalangeal)	Metacarpal and proximal phalanx	Synovial; condyloid	Diarthrotic; biaxial; flexion, extension, abduction, adduction, circumduction of fingers
	Finger (interphalangeal)	Adjacent phalanges	Synovial; hinge	Diarthrotic; uniaxial; flexion, extension of fingers

# JOINTS OF THE SHOULDER

- Sternoclavicular
- Acromioclavicular

# Shoulder Girdle - Articulations

## Joint

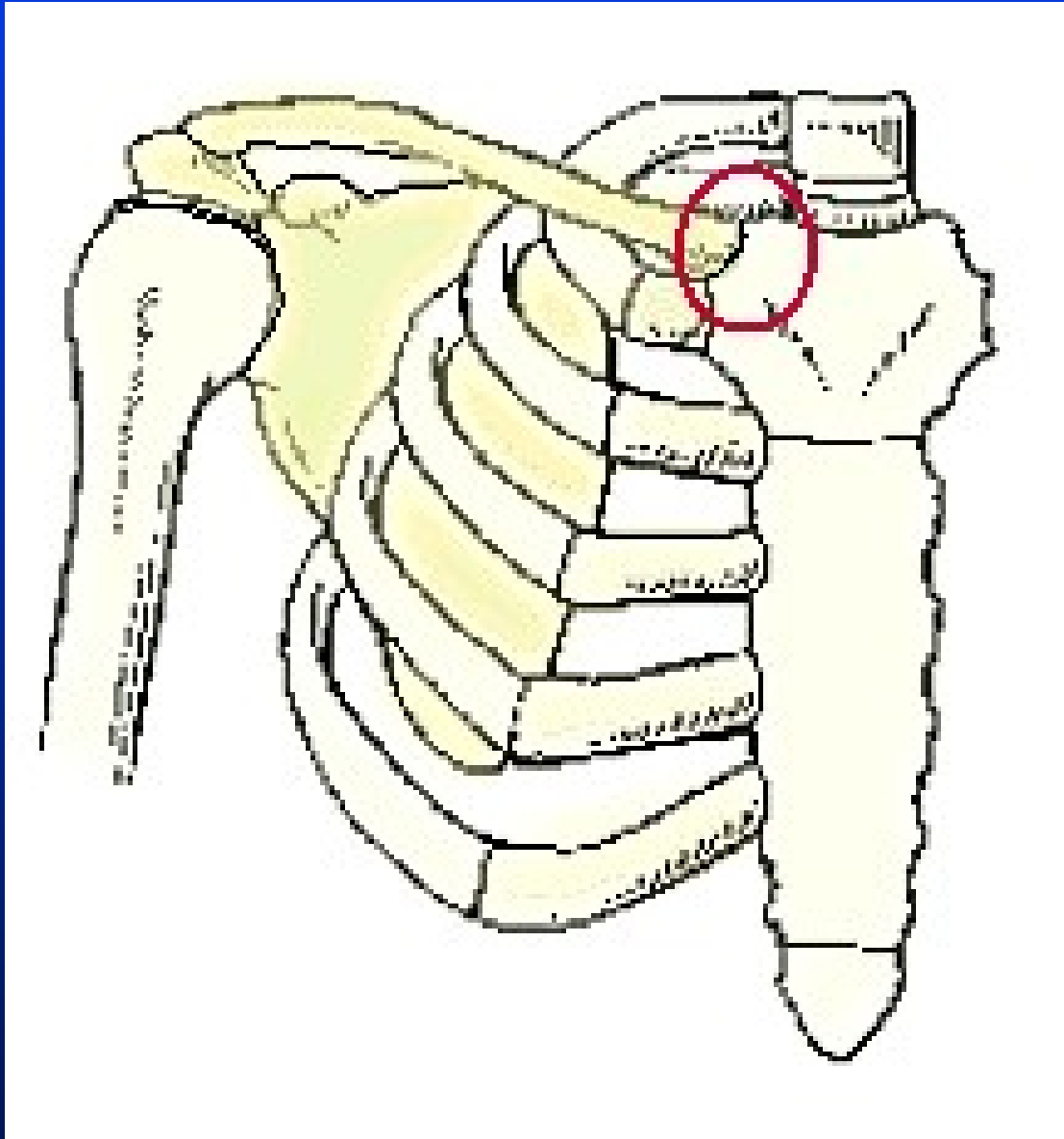
## Type of Joint

## Movement

**Sternoclavicular**

**Double gliding;  
special feature:  
articular disc**

**Rotation on axis  
through articular facet  
(elevation, depression  
of shoulder); rotation  
on vertical axis of  
sternum (protraction,  
retraction of shoulder);  
rotation of clavicle on  
articular disc  
circumduction of arm)**



# **STERNOCLAVICULAR JOINT**

- Between manubrium and medial end of the clavicle
- Only true articulation...
- Synovial joint
  - Contains articular disc
- Ligaments
  - Sternoclavicular ligament
  - Costoclavicular ligament
  - Interclavicular ligament

# Sternoclavicular Joint

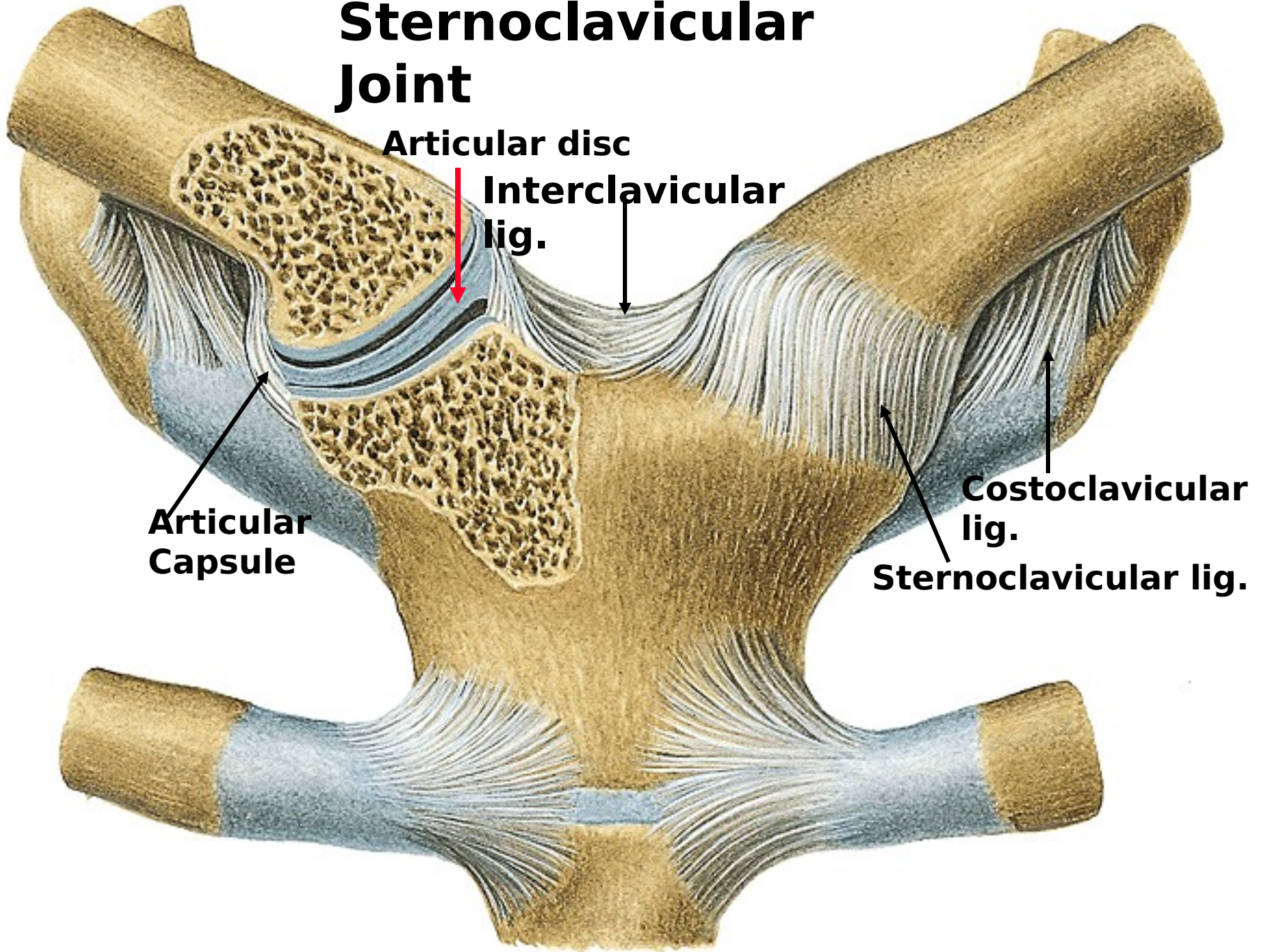
Articular disc

Interclavicular  
lig.

Articular  
Capsule

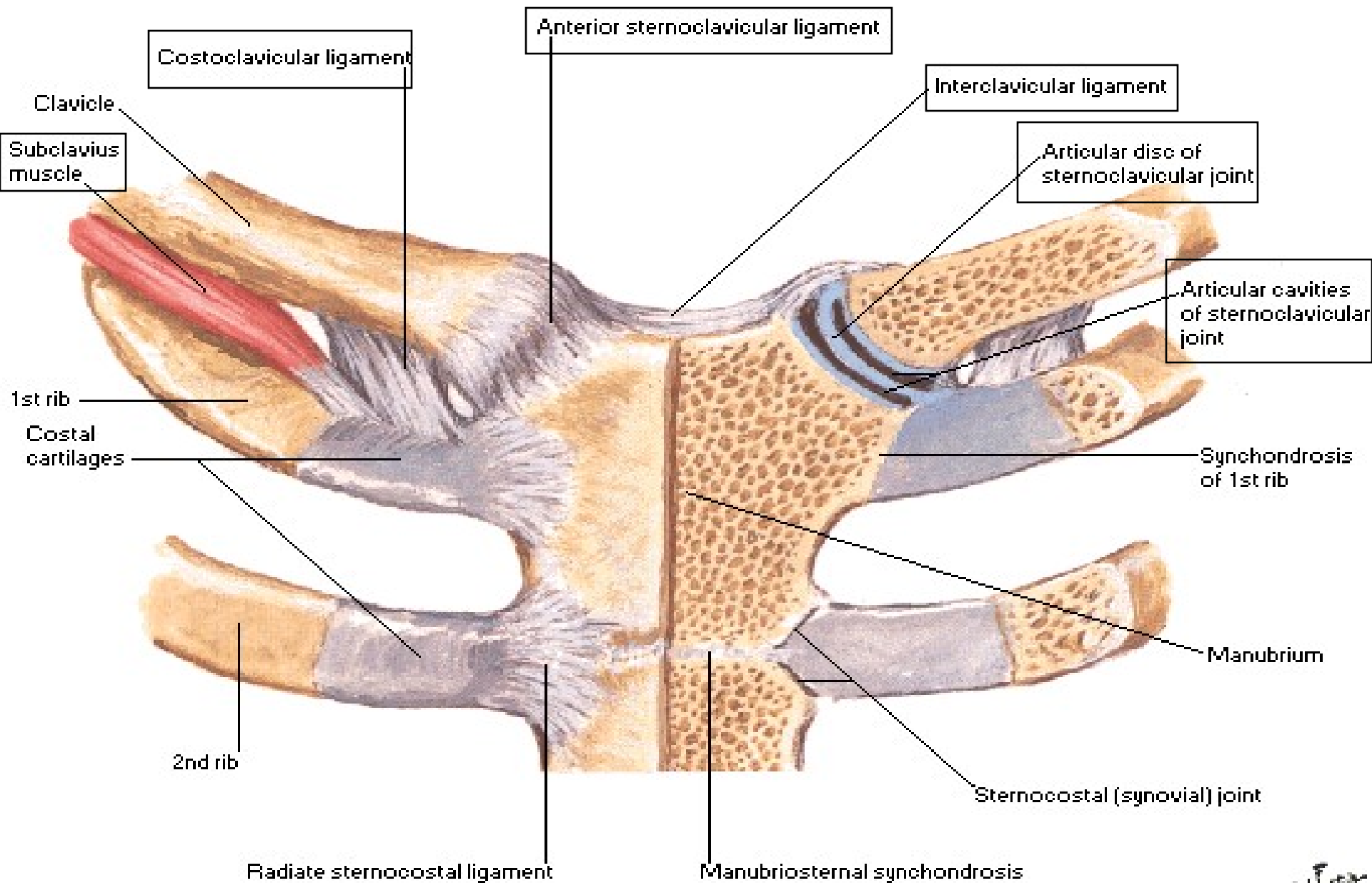
Costoclavicular  
lig.

Sternoclavicular lig.





# Sternoclavicular Joint



# Shoulder Girdle - Articulations

Joint

Type of Joint

Movement

**Acromioclavicular joint**

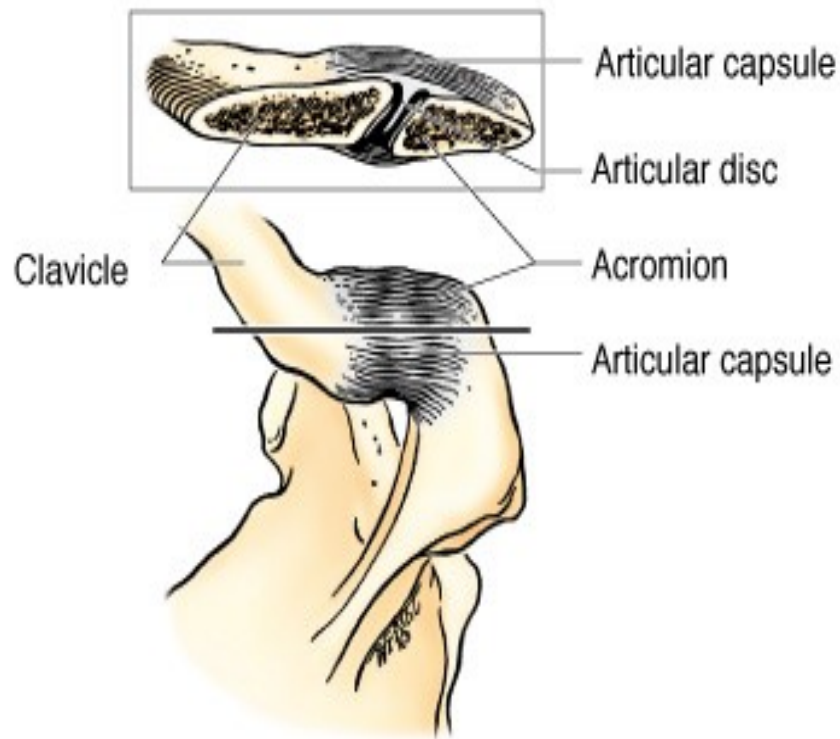
**Plane or gliding**

**Gliding motion of articular end of clavicle on acromion; rotation of scapula forward**

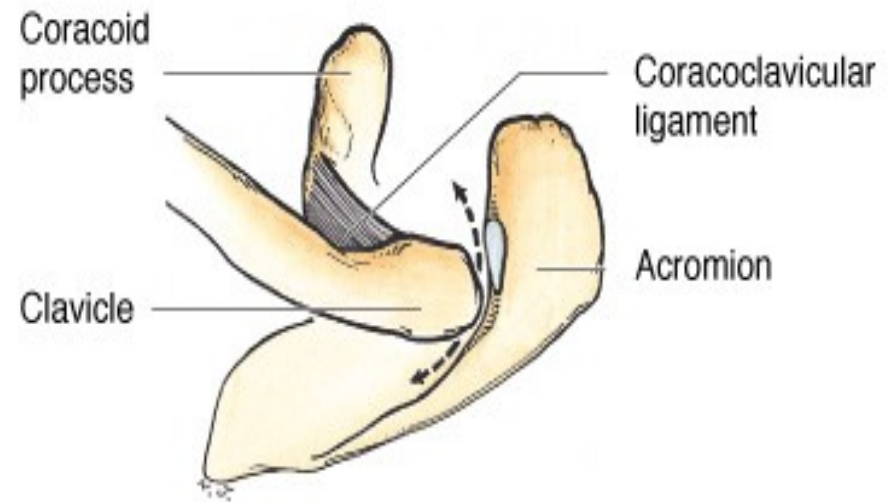
# ACROMIOCLAVICULAR JOINT

- Between acromion and lateral end of the clavicle
- Synovial joint
- Site of shoulder separations
- Stabilizing ligaments
  - Acromioclavicular ligament
  - Coracoclavicular ligaments
    - Trapezoid; Conoid

6.62A, B. Acromioclavicular (AC) joint and coracoclavicular (CA) ligament.

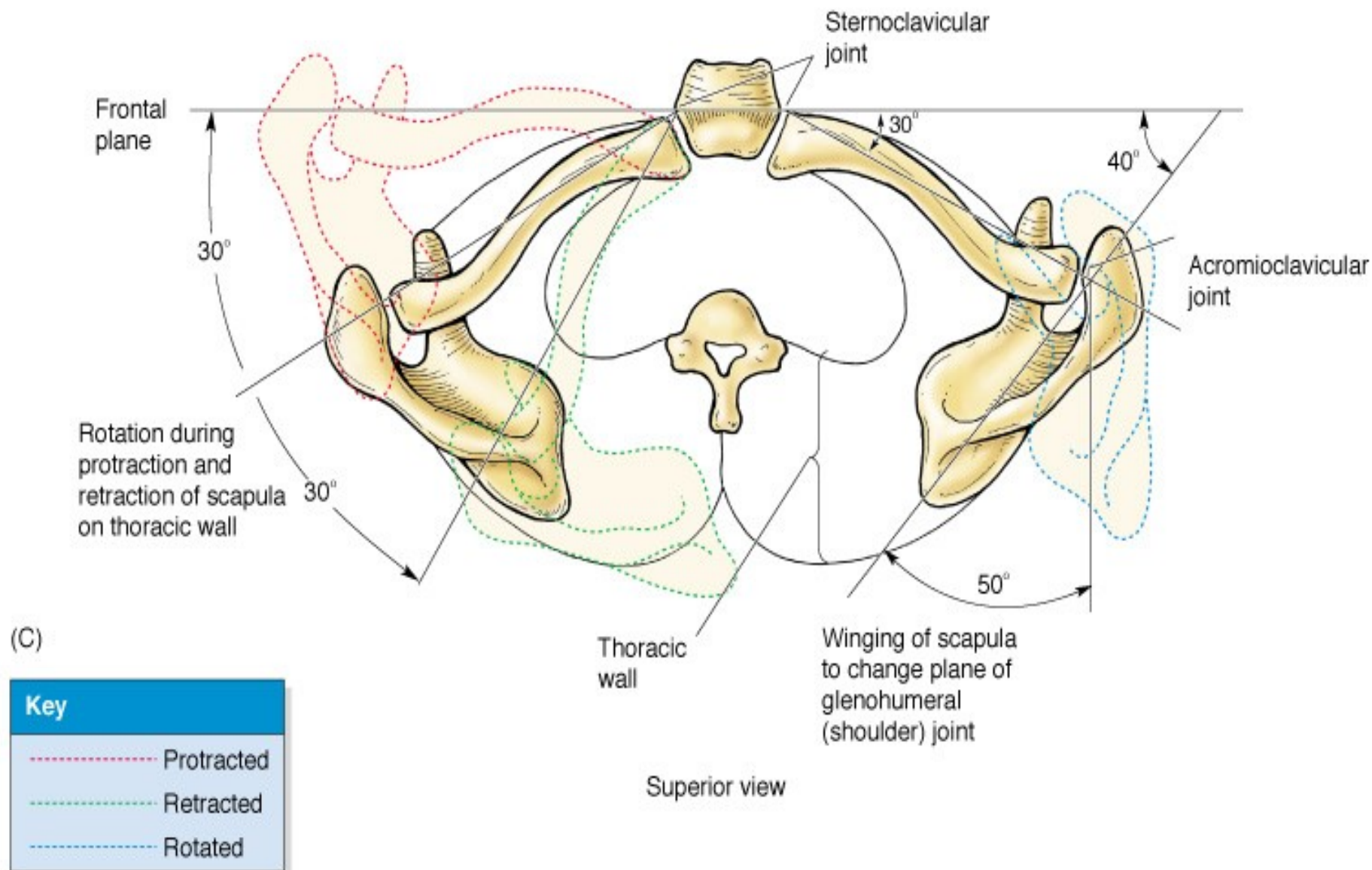


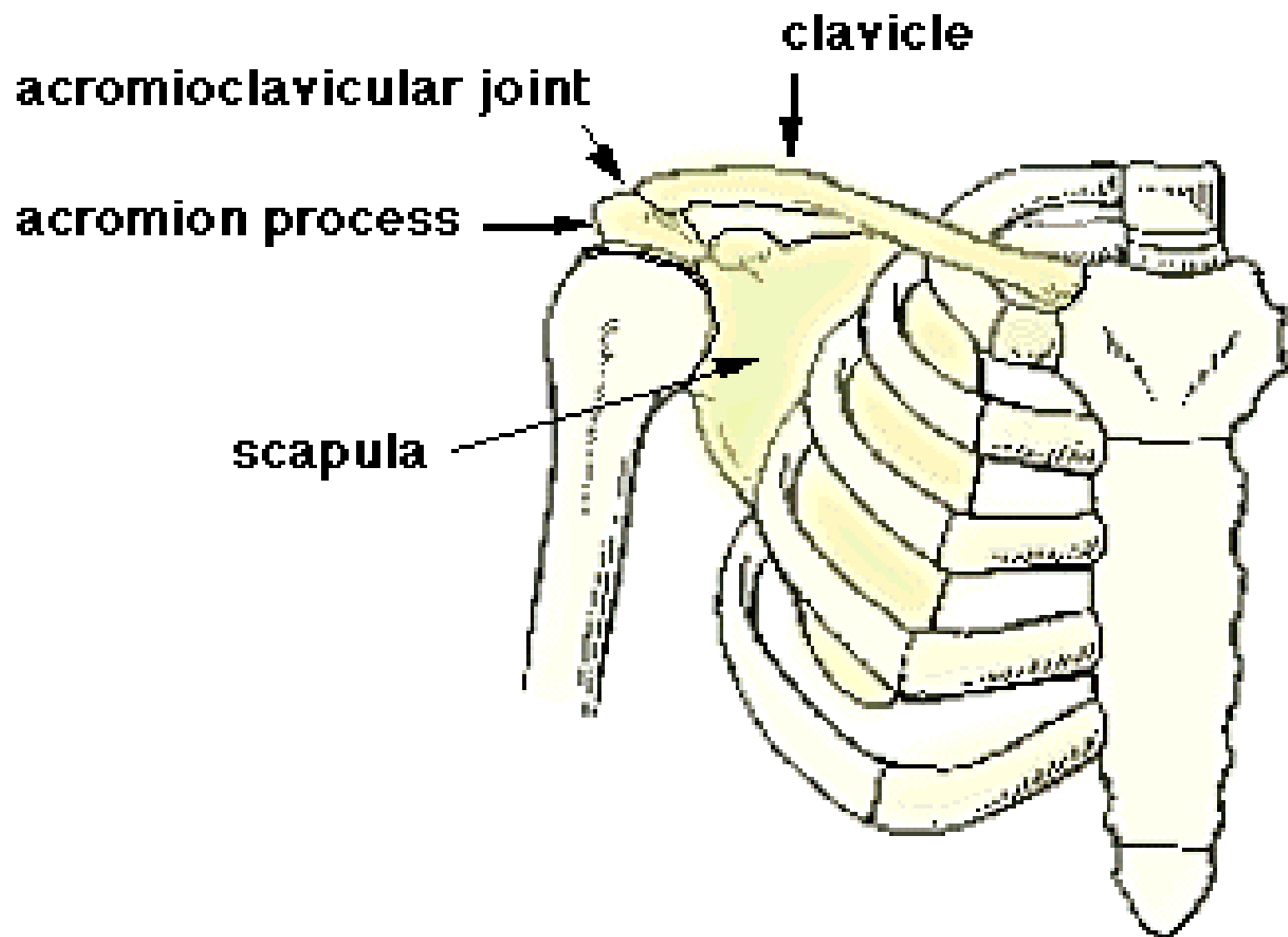
(A)



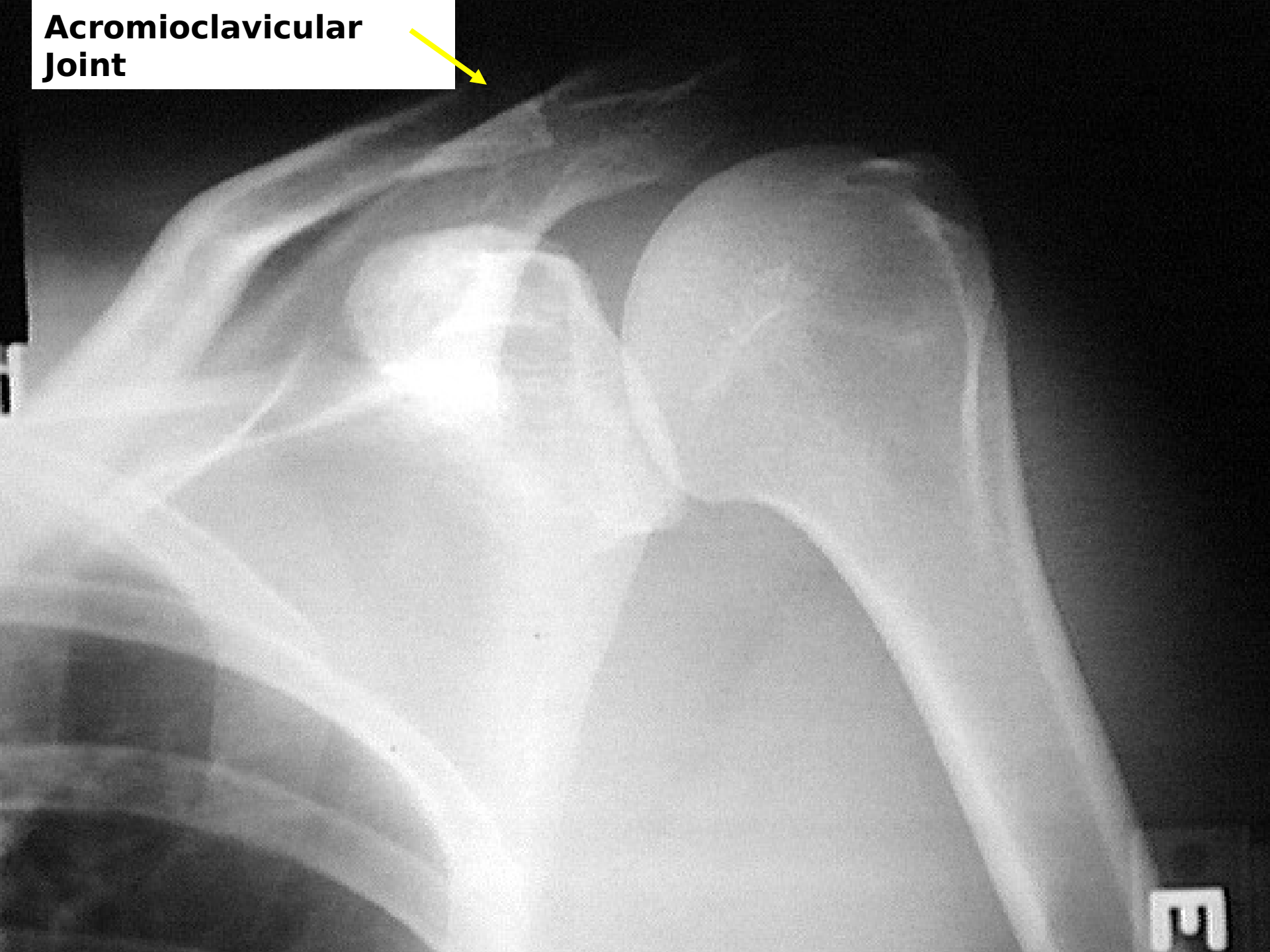
(B)

6.62 C. Clavicular movements at the sternoclavicular (SC) and AC joints.





**Acromioclavicular  
Joint**



Fluoroscopy, Shoulder

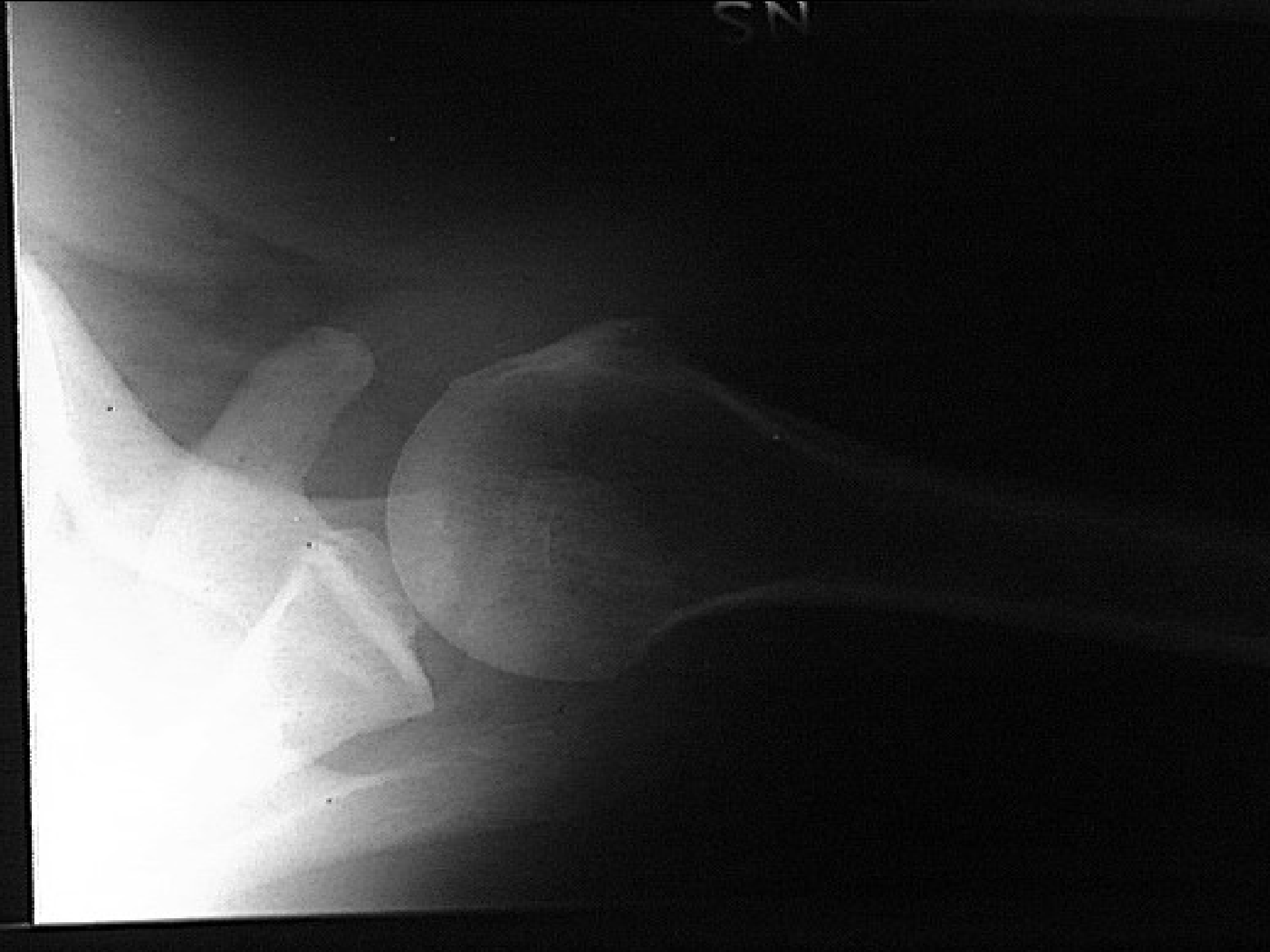




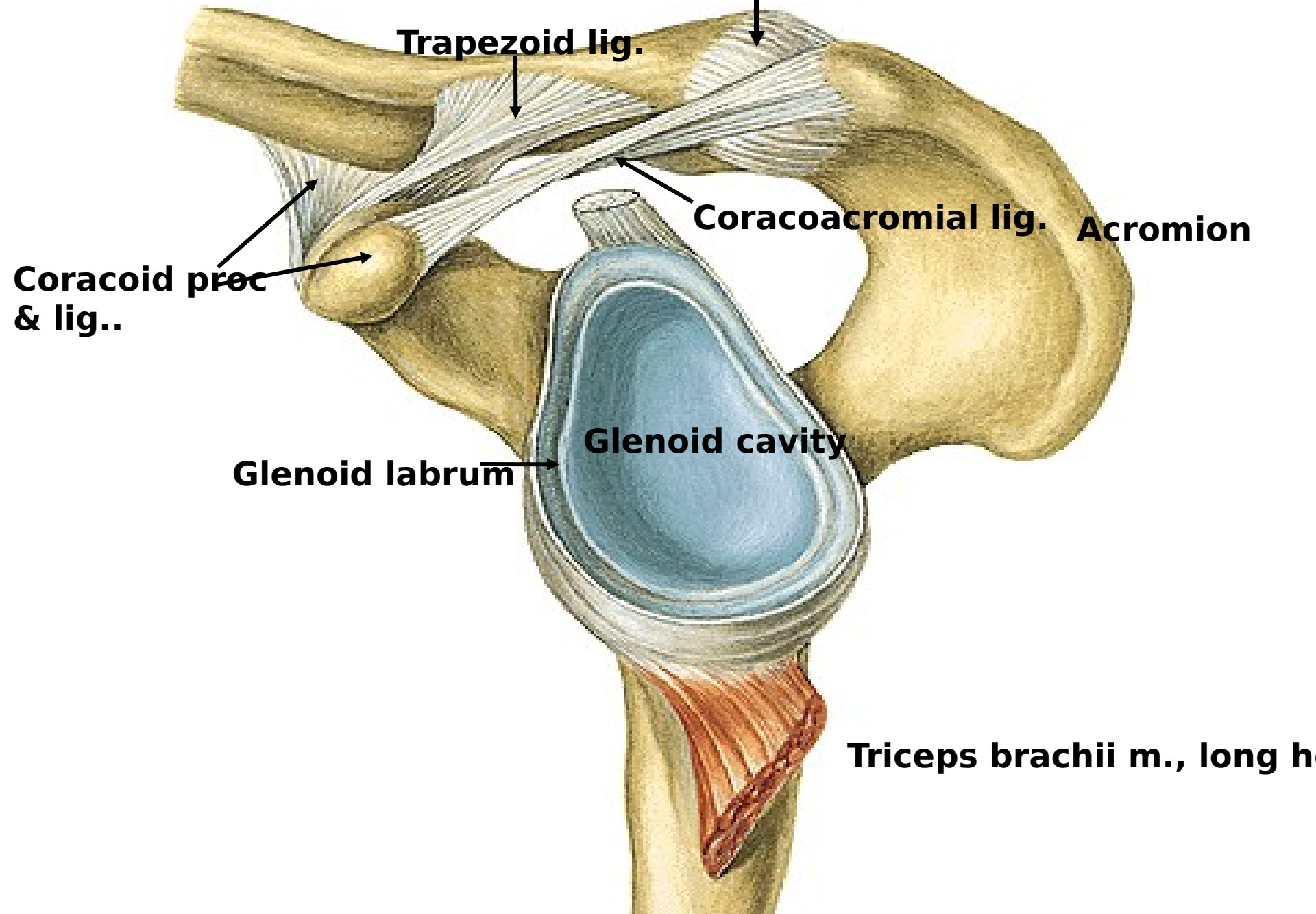
**Acromioclavicular  
Joint**



SN



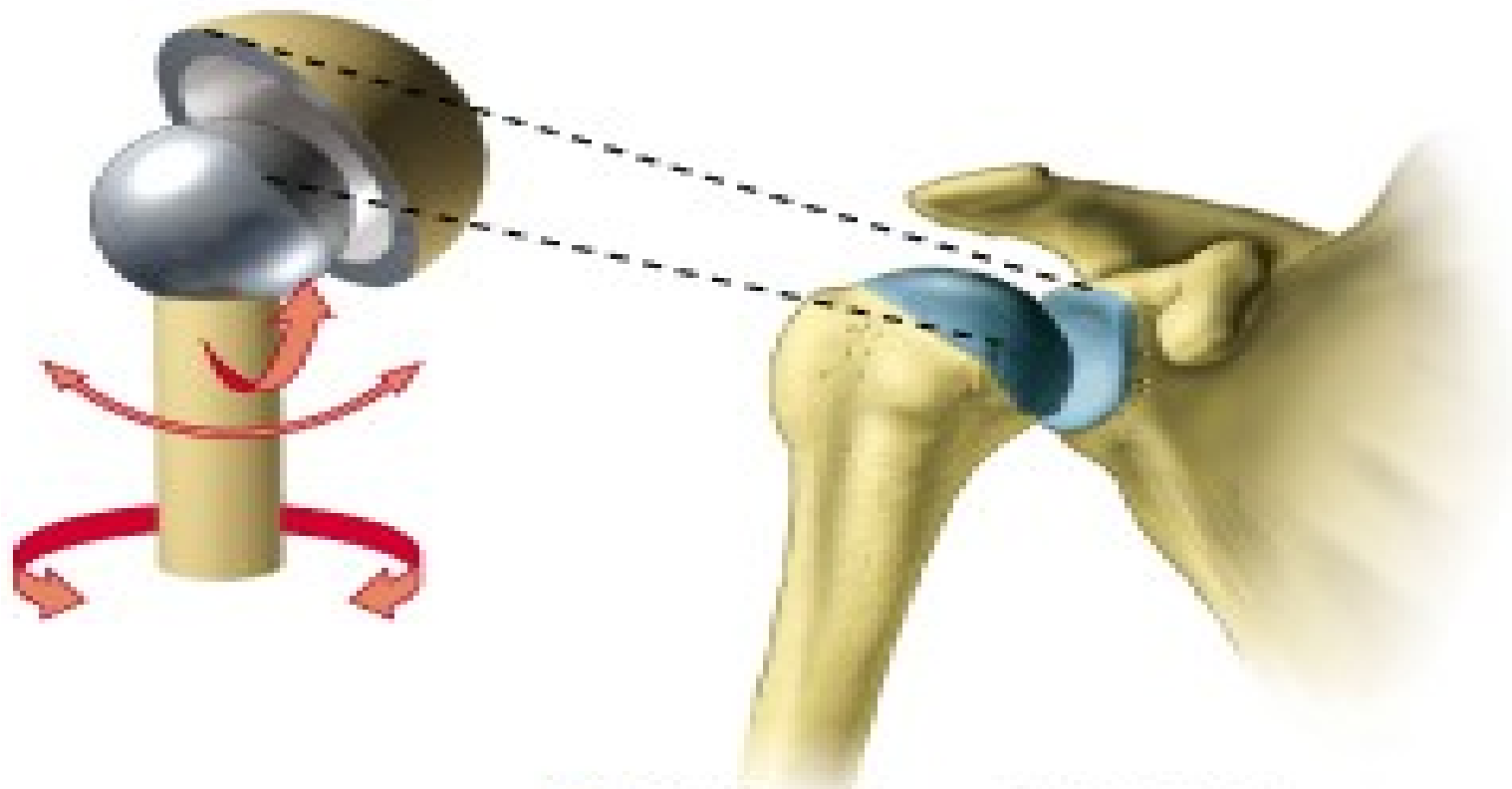
# ACROMIONCLAVICULAR JOINT



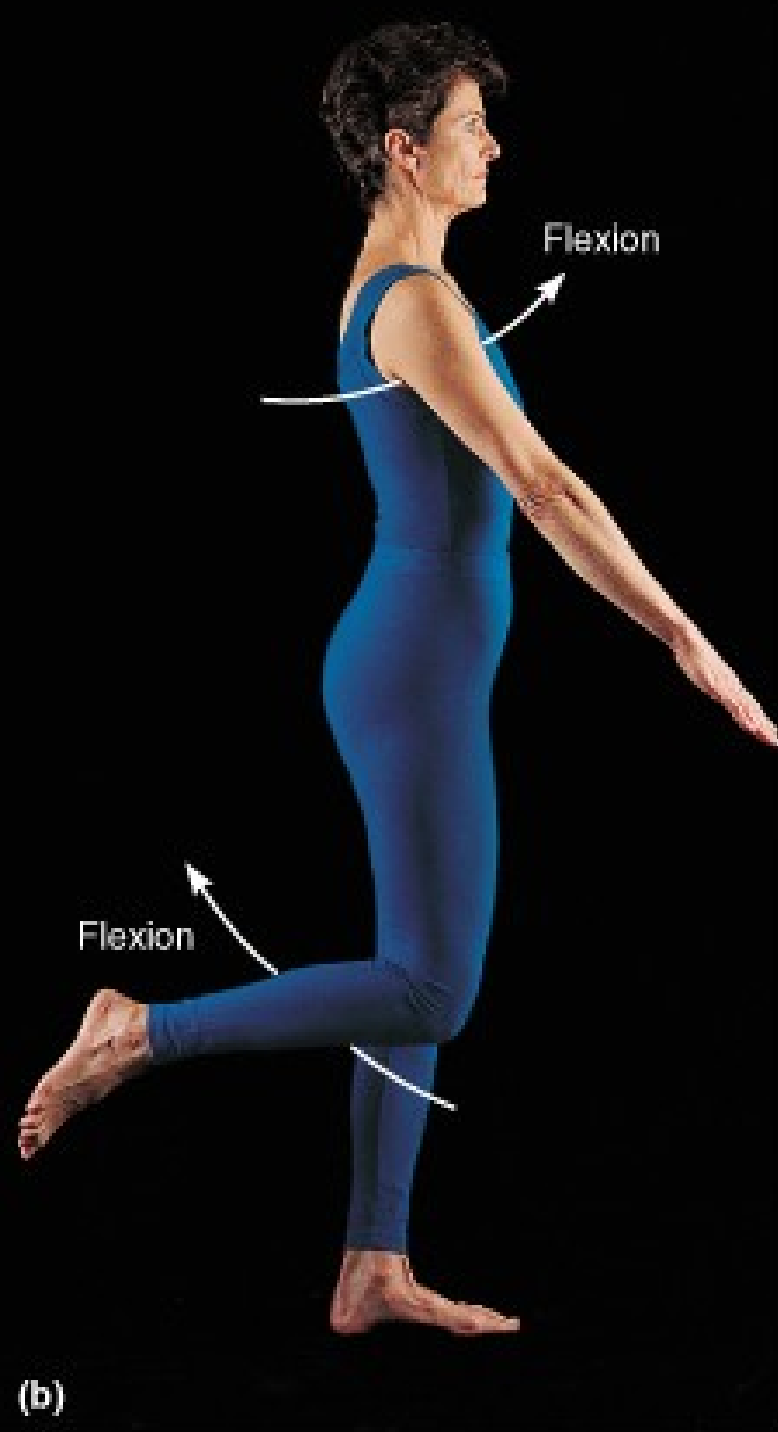
# SHOULDER JOINT

# Upper Limb - Articulations

<u>Joint</u>	<u>Type of Joint</u>	<u>Movement</u>
<b>Shoulder joint</b> (Glenohumeral)	<b>Ball-and-socket</b>	<b>Flexion (protraction)</b> <b>Extension (retraction)</b> <b>Abduction</b> <b>Adduction</b> <b>Medial rotation</b> <b>Lateral rotation</b> <b>Circumduction</b>



**f** Ball and socket joint



(b)

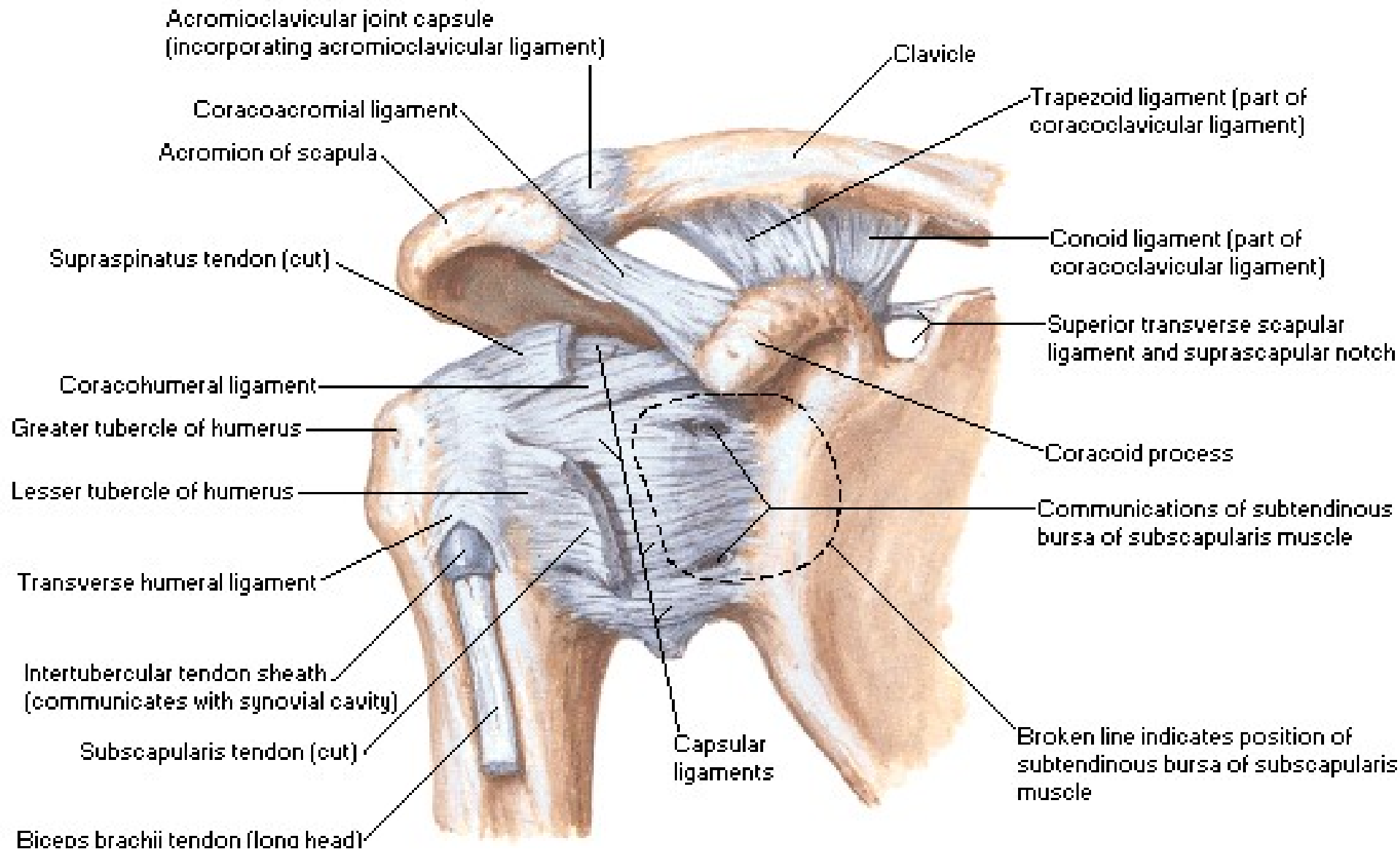
Extension

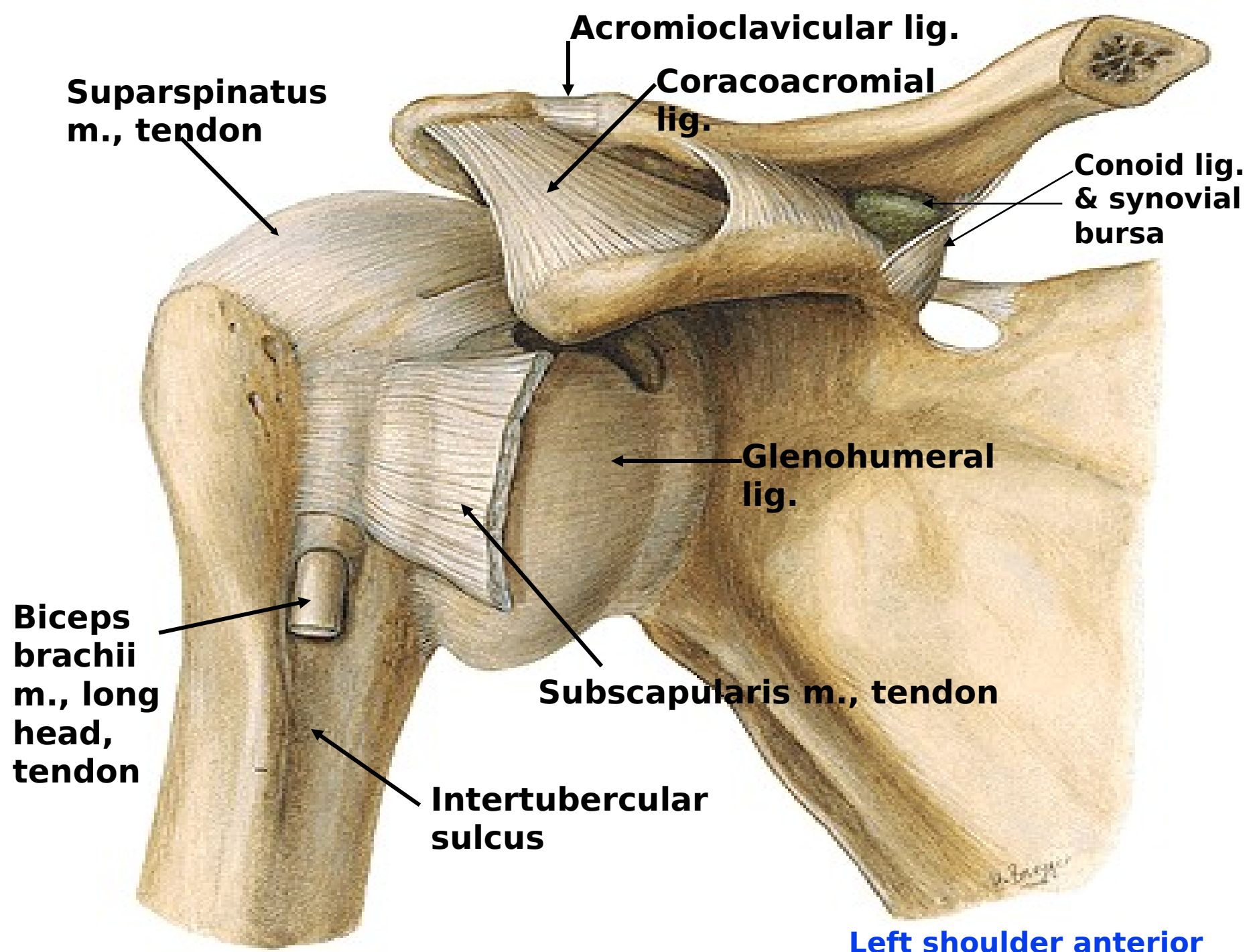




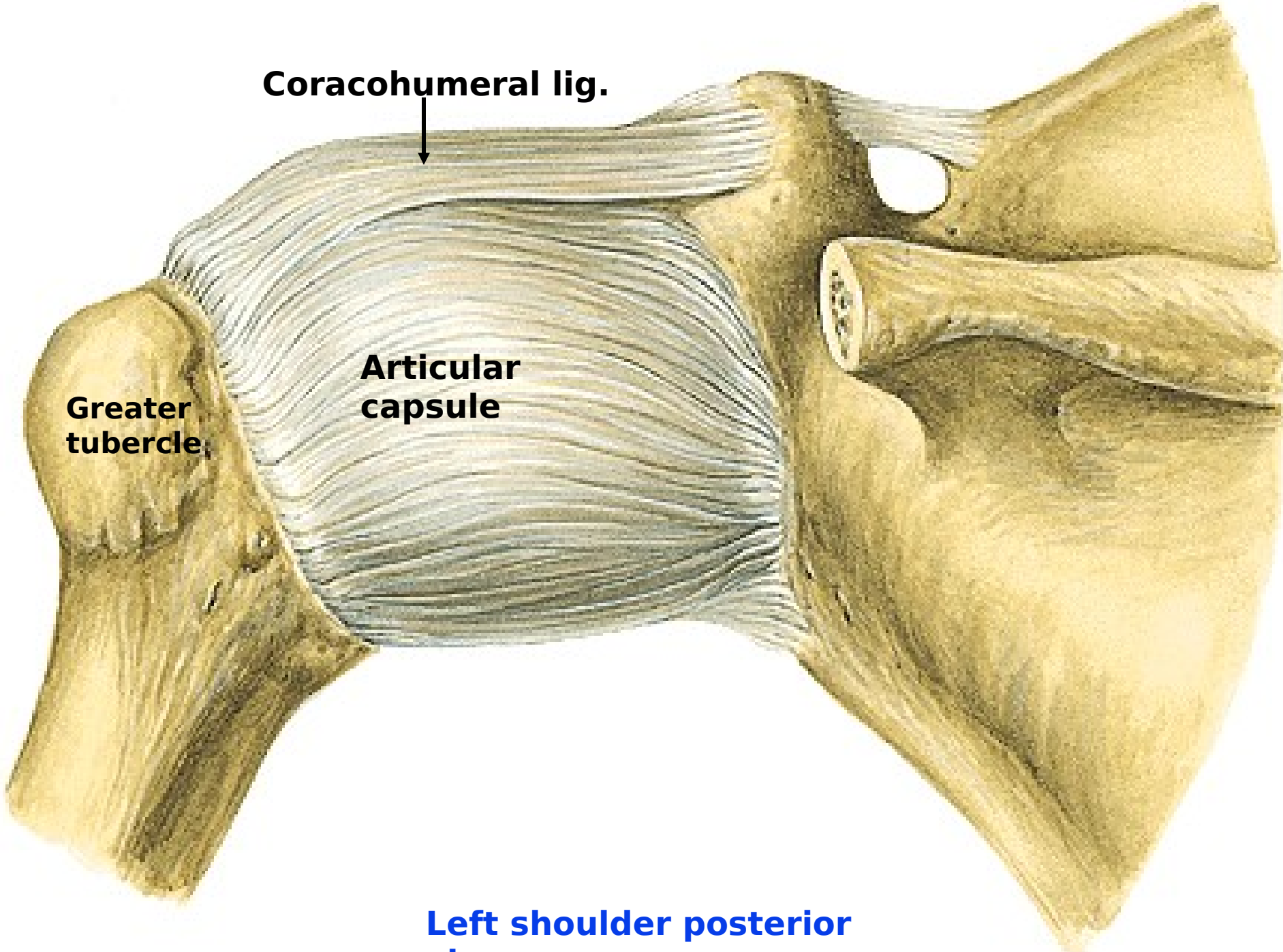
# Shoulder [Glenohumeral] Joint

## Anterior View - Tendons and Ligaments









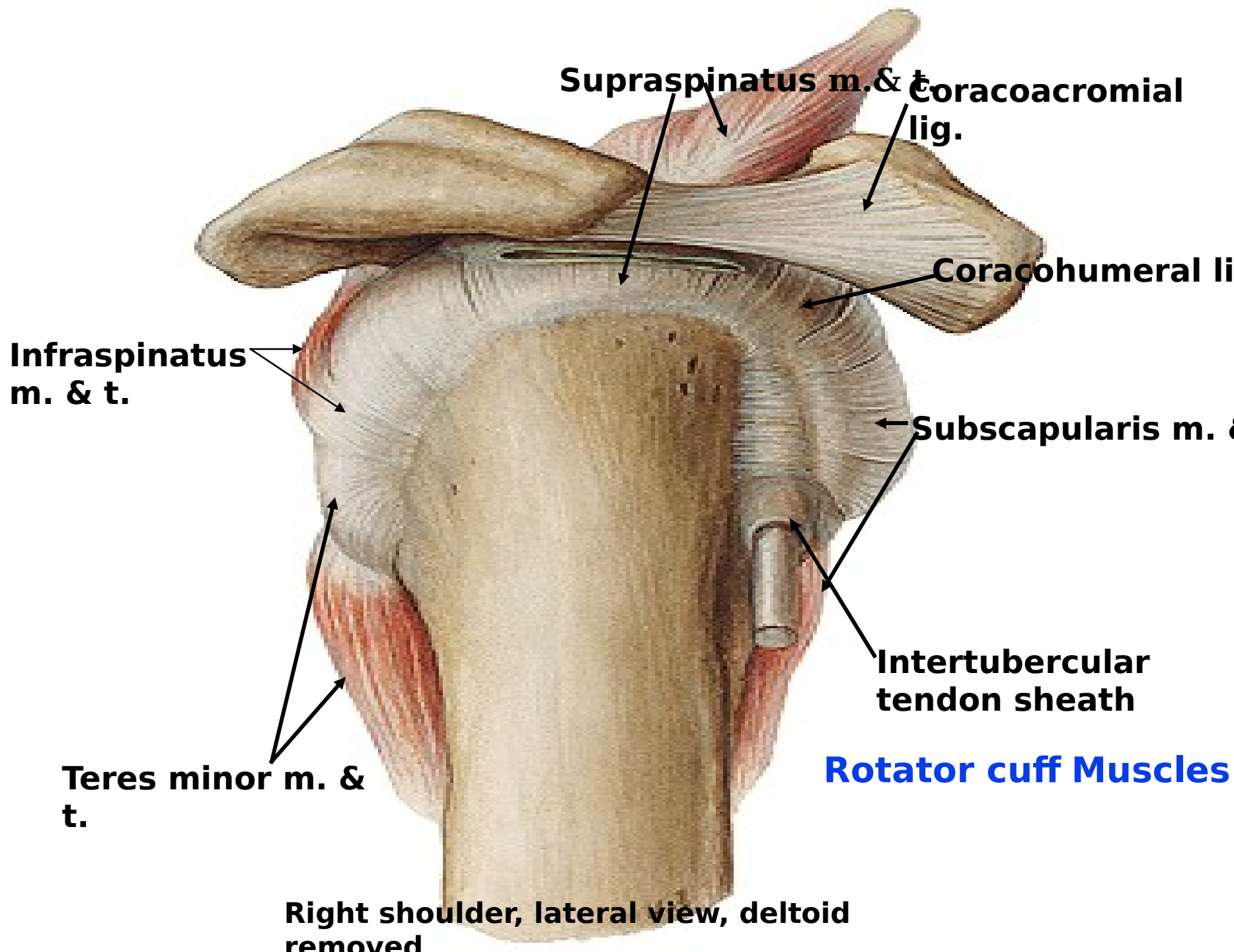
**Coracohumeral lig.**

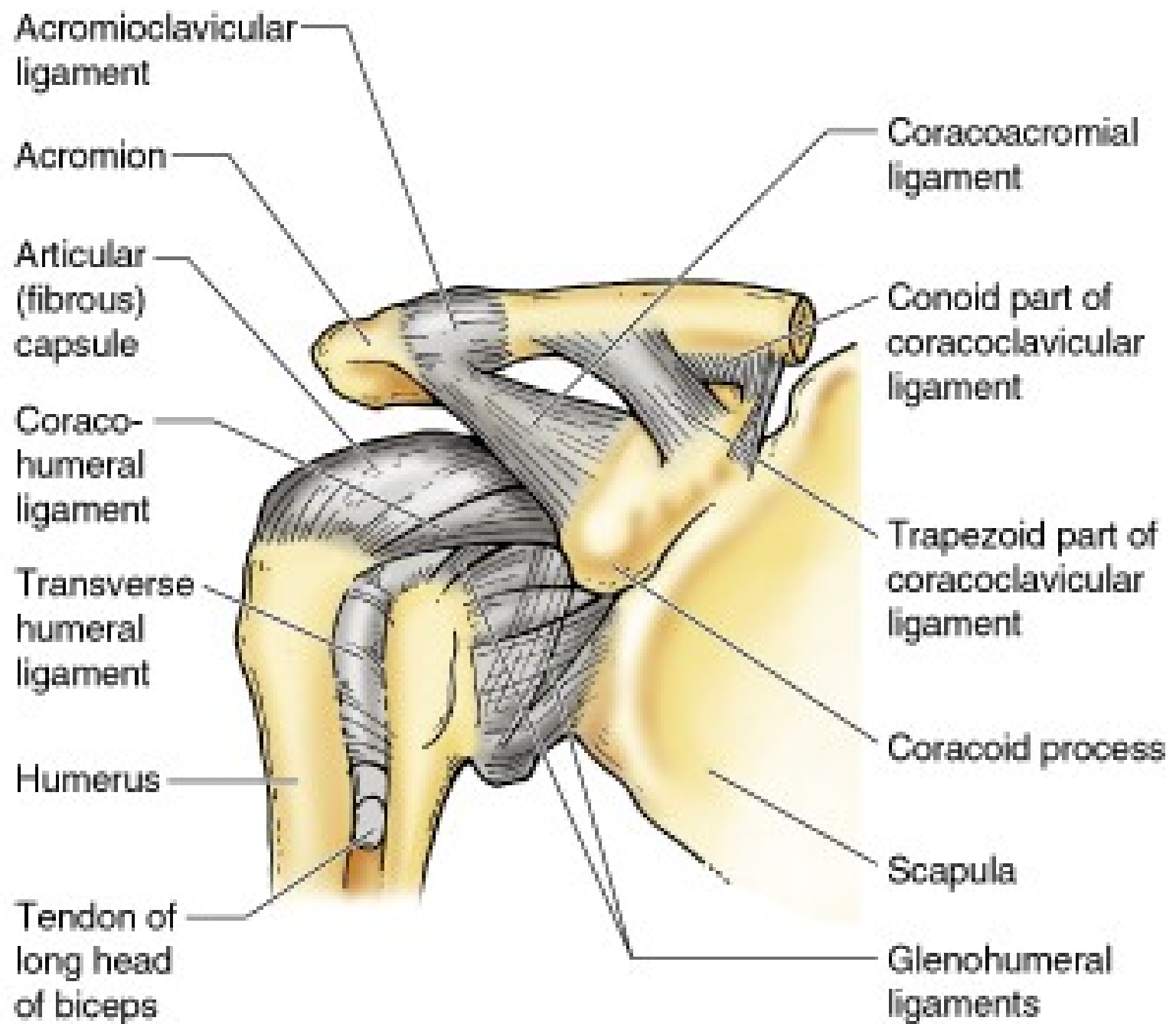


**Articular  
capsule**

**Greater  
tubercle**

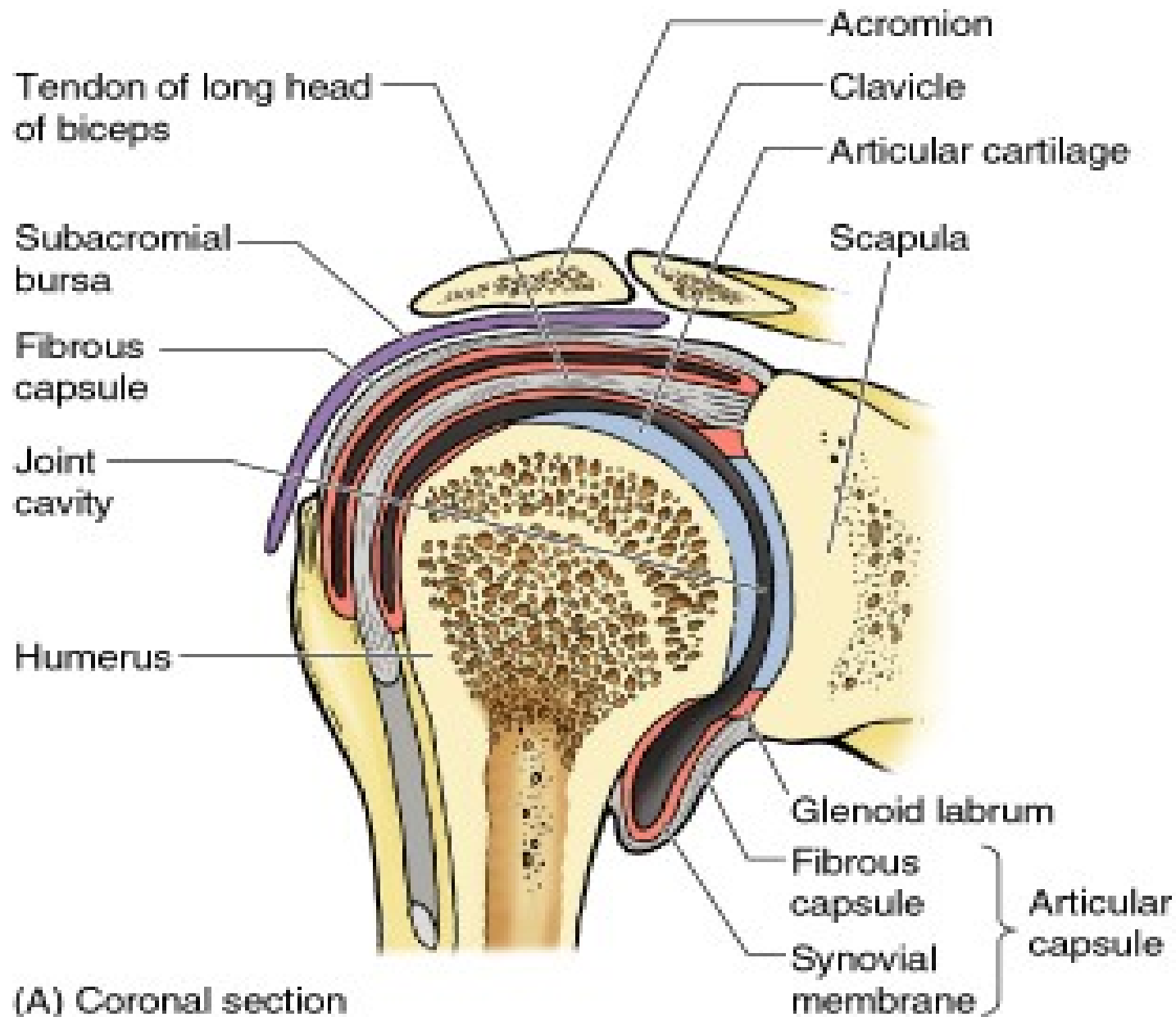
**Left shoulder posterior  
view**

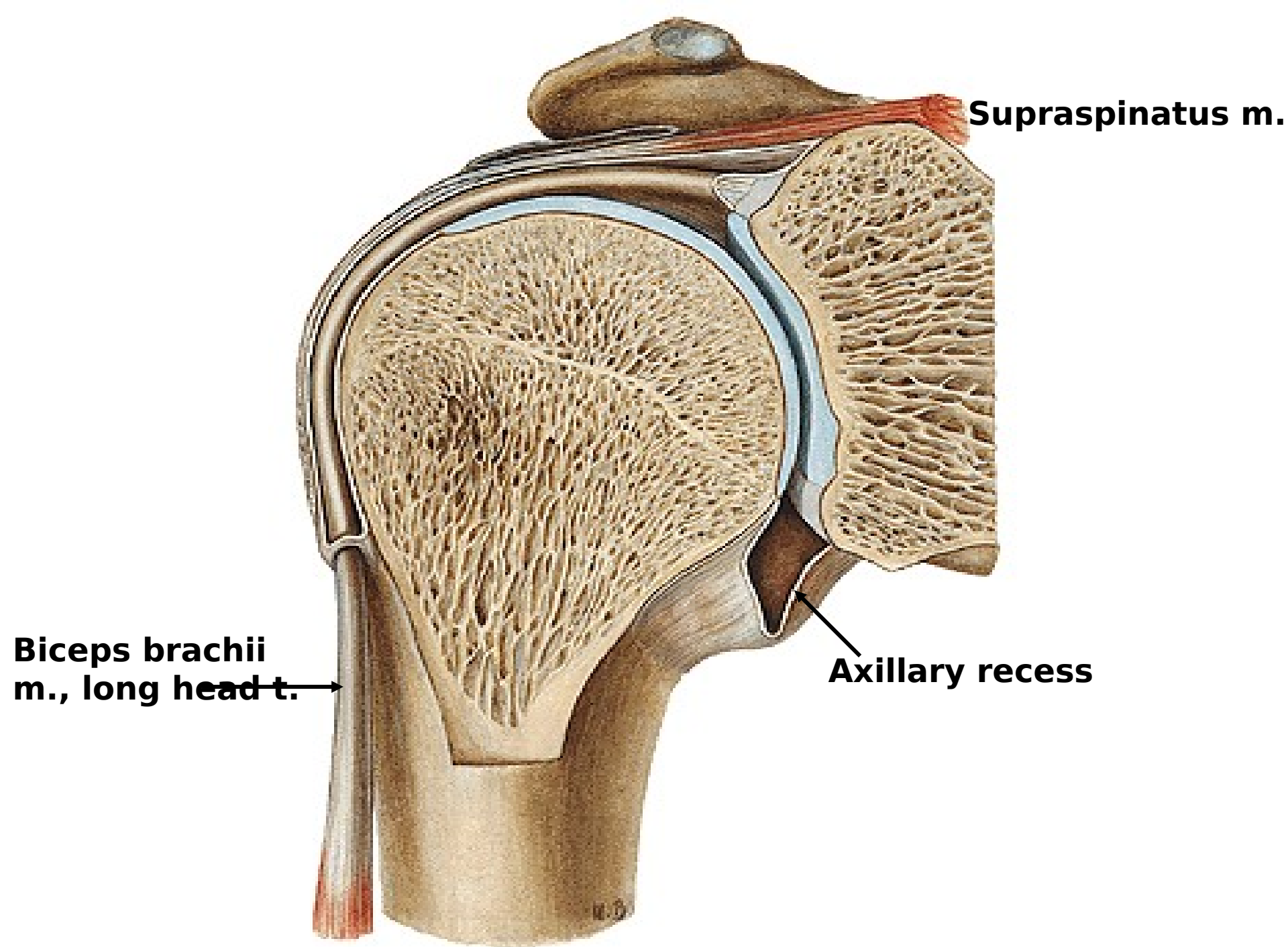




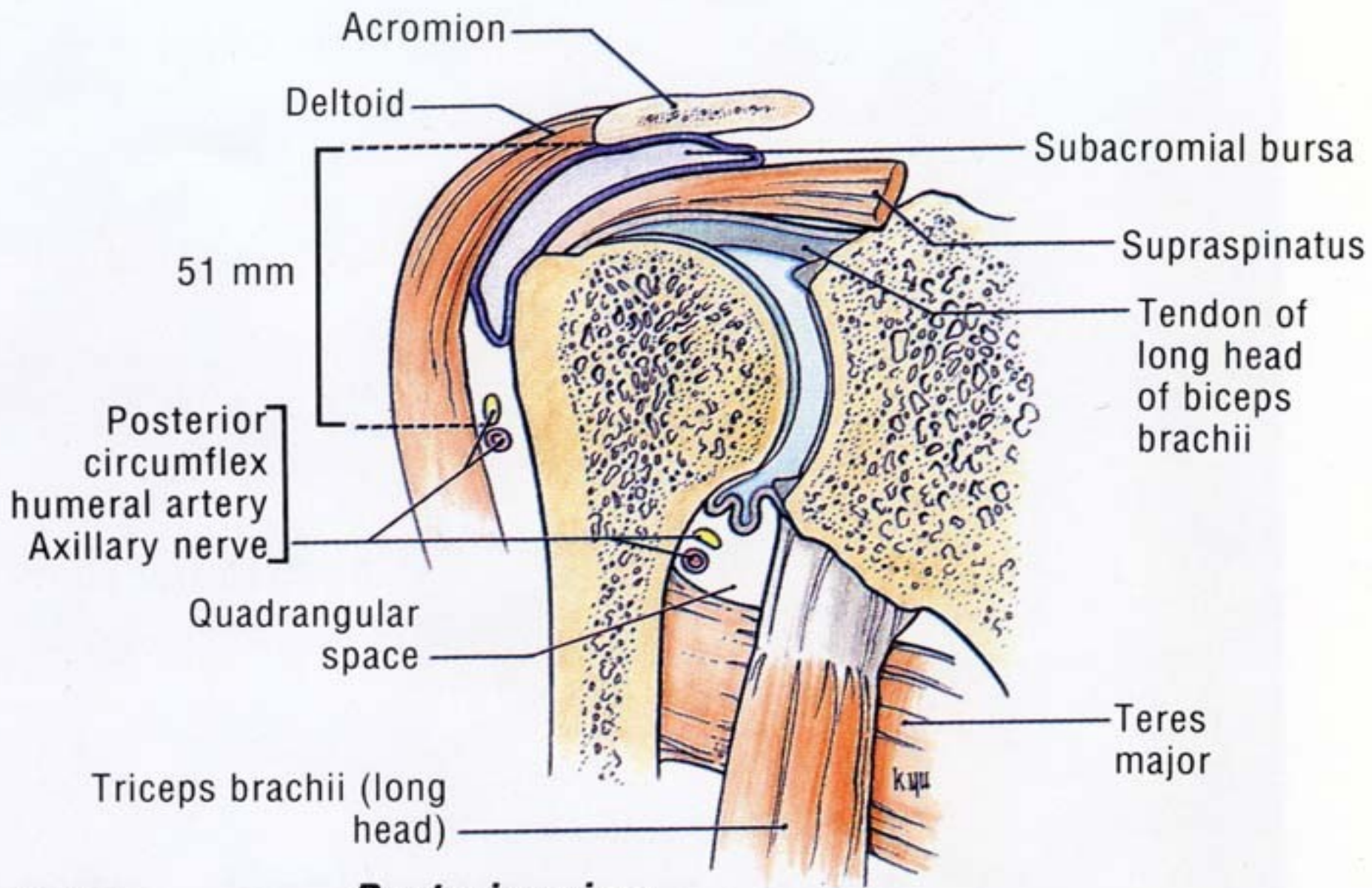
(B) Anterior view

## 6.65A, B. Glenohumeral joint.



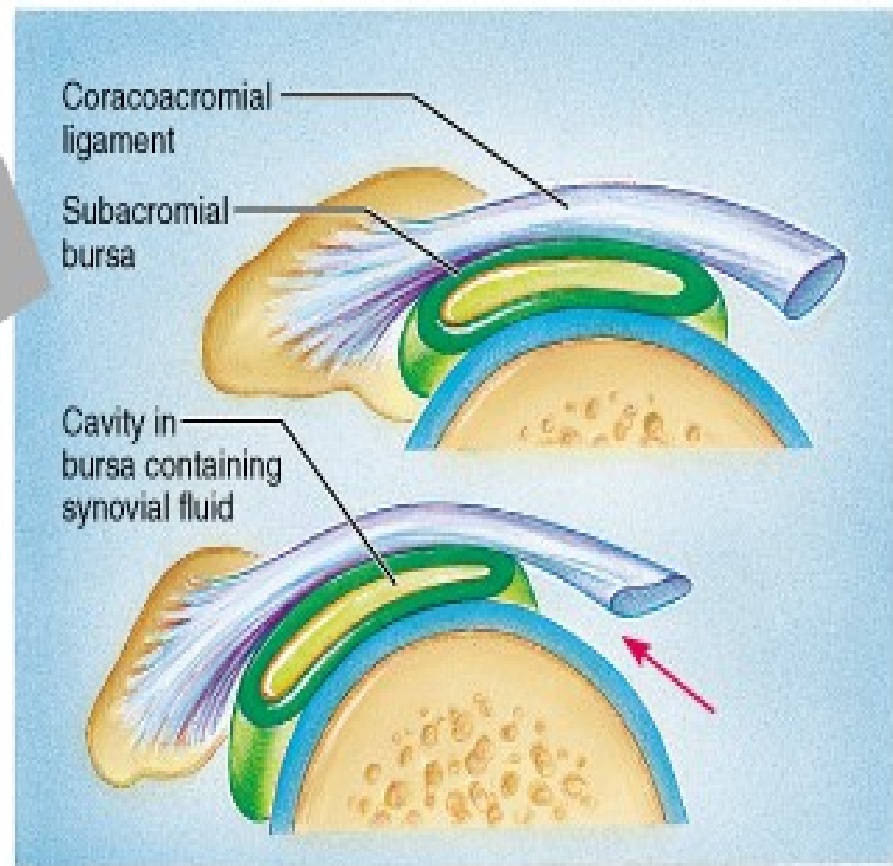
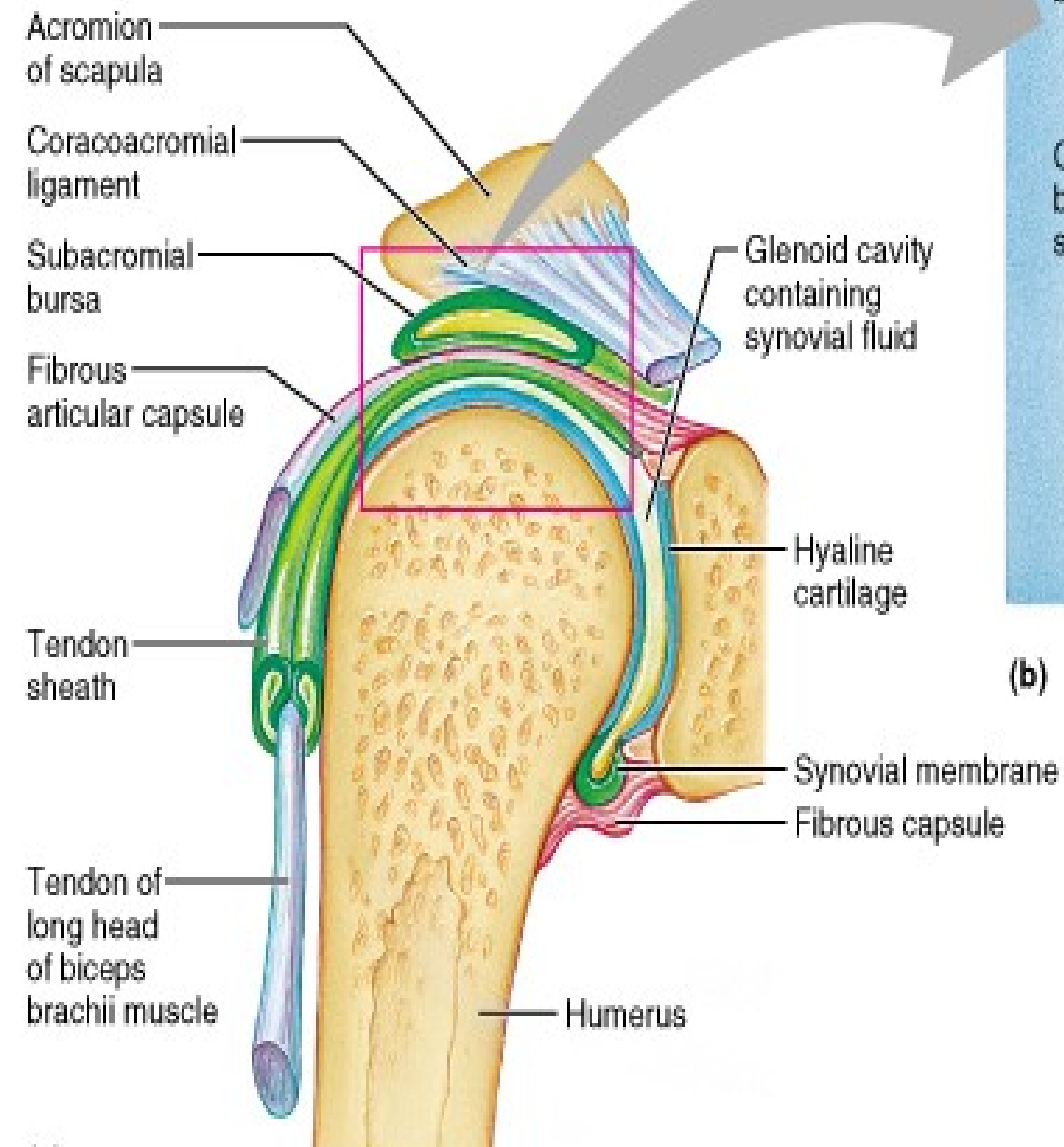




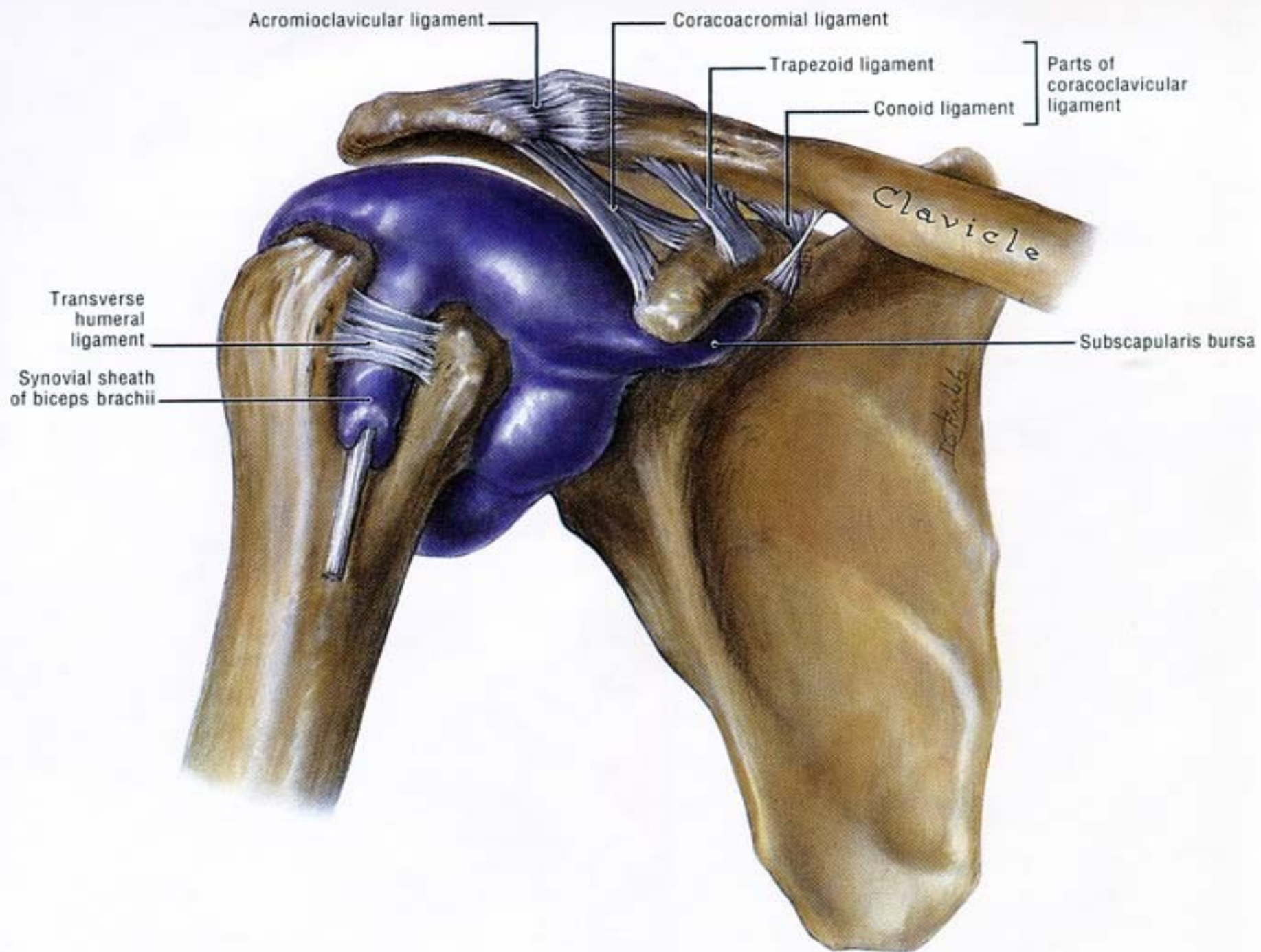


## 6.47 *Posterior view*

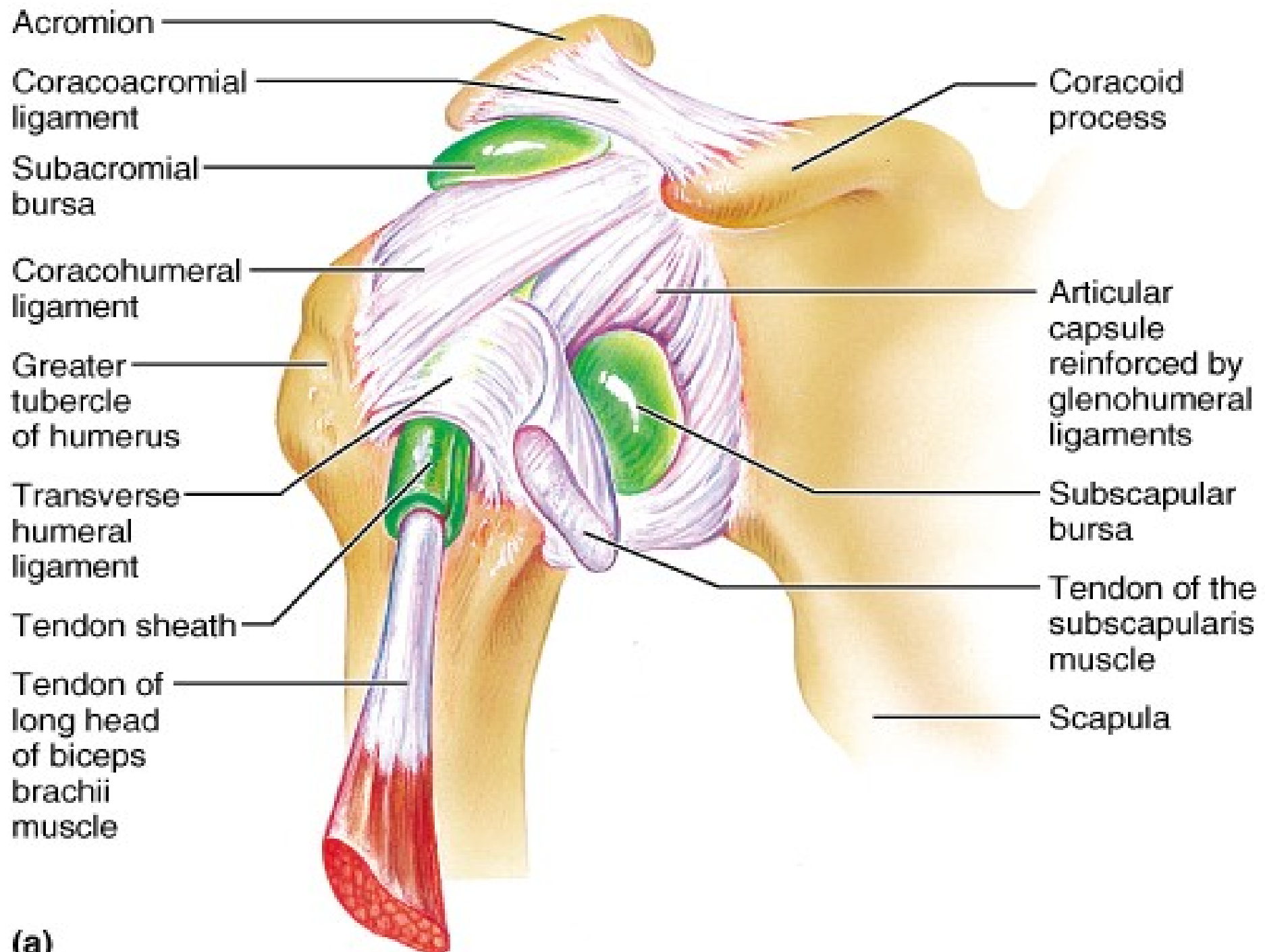
### Subacromial bursa, coronal section of the shoulder region



(b)

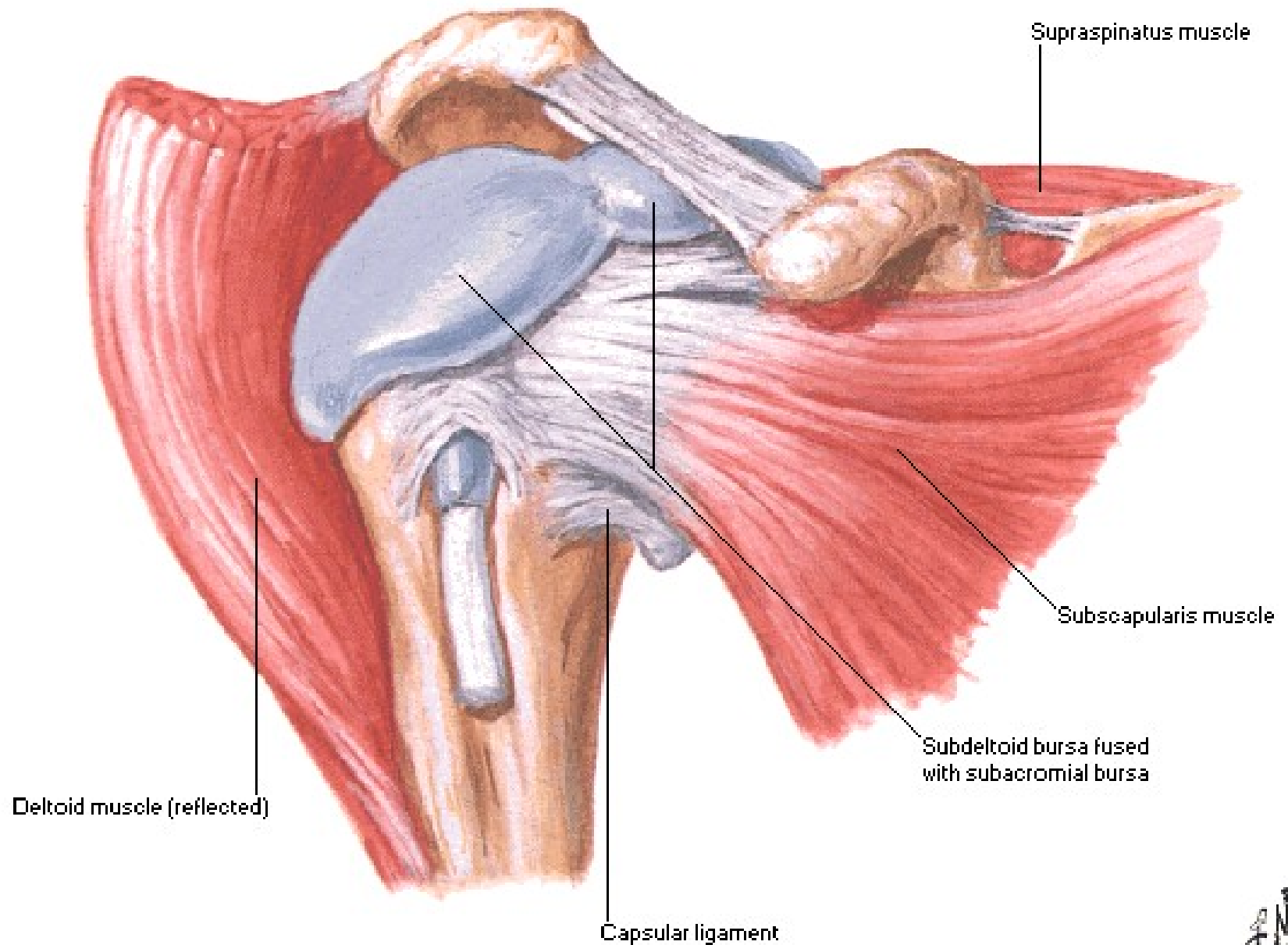




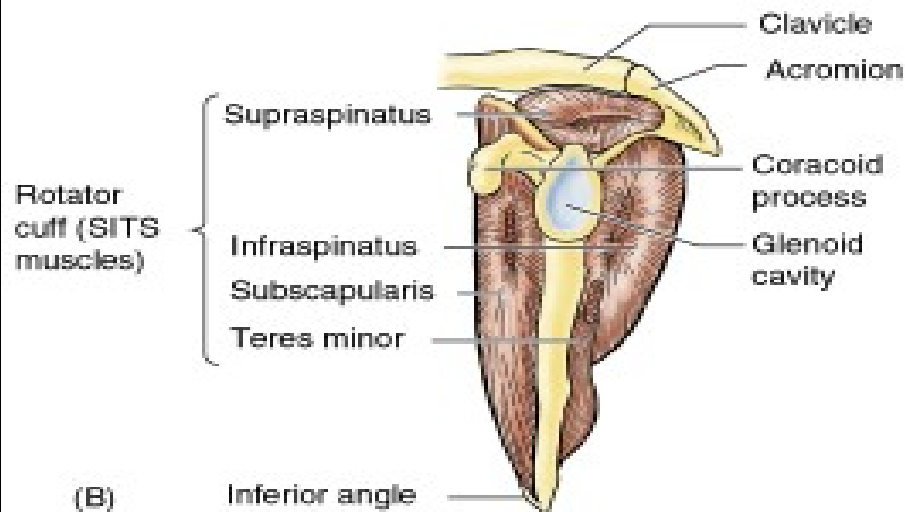
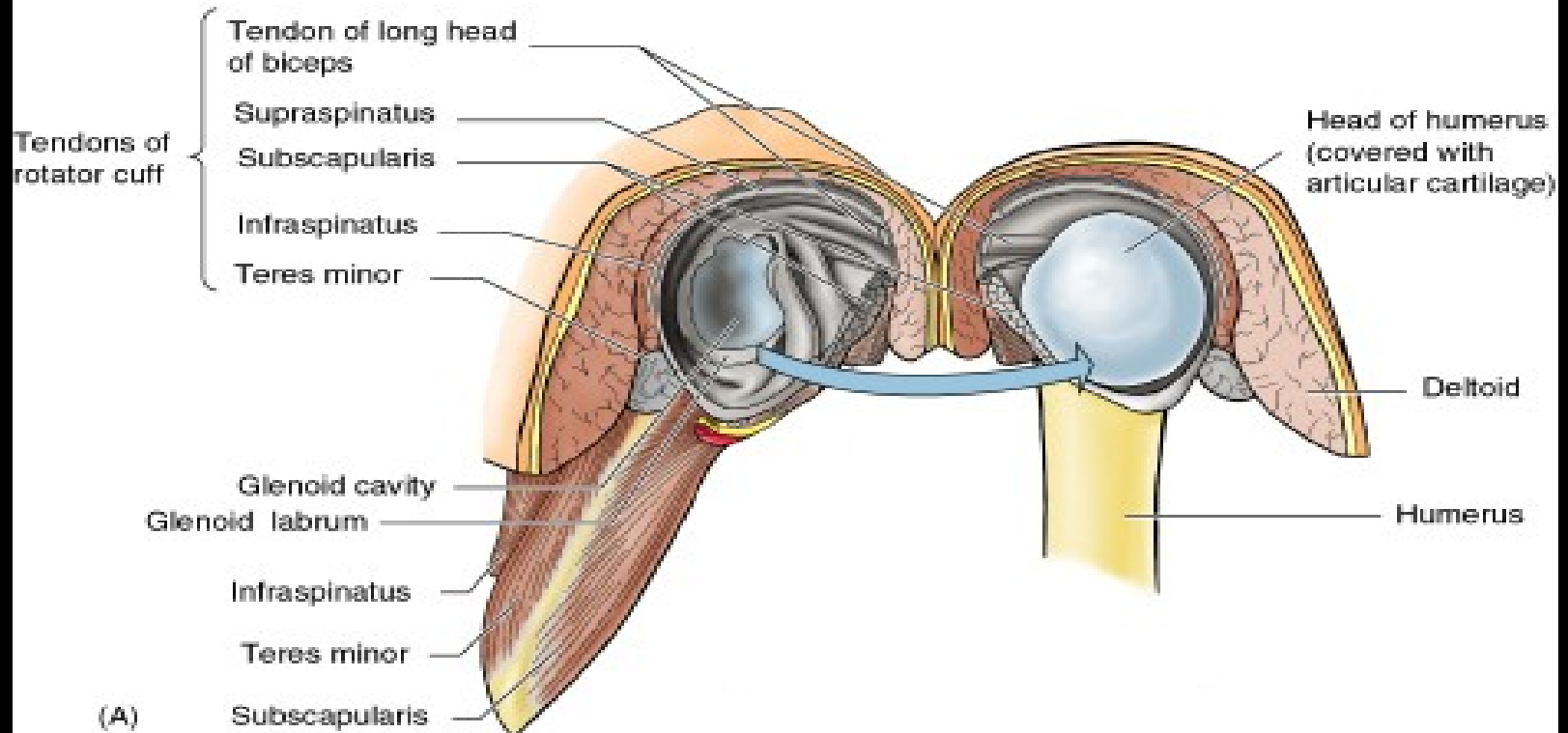


# Shoulder [Glenohumeral] Joint

## Anterior View - Supporting Muscles

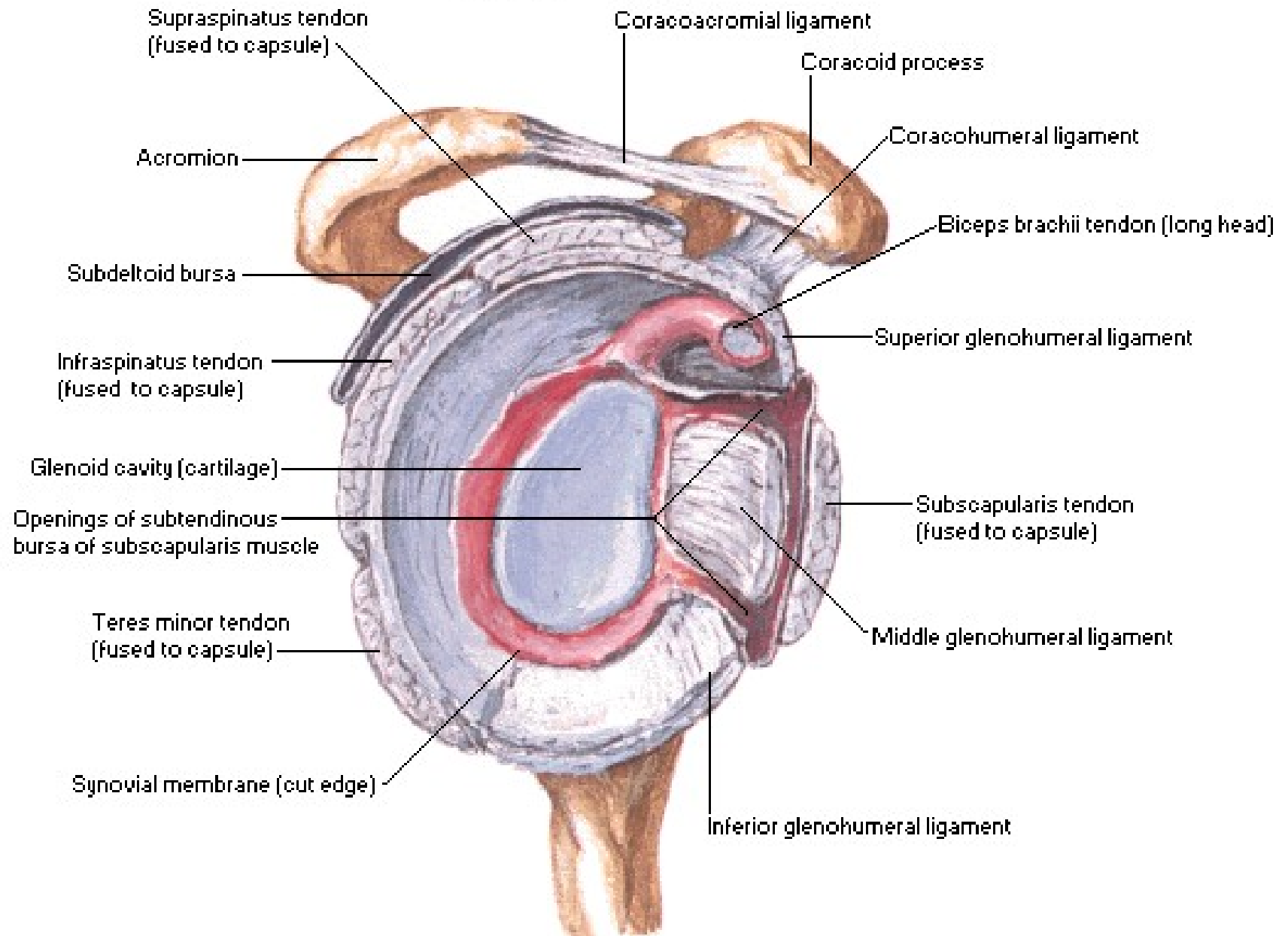


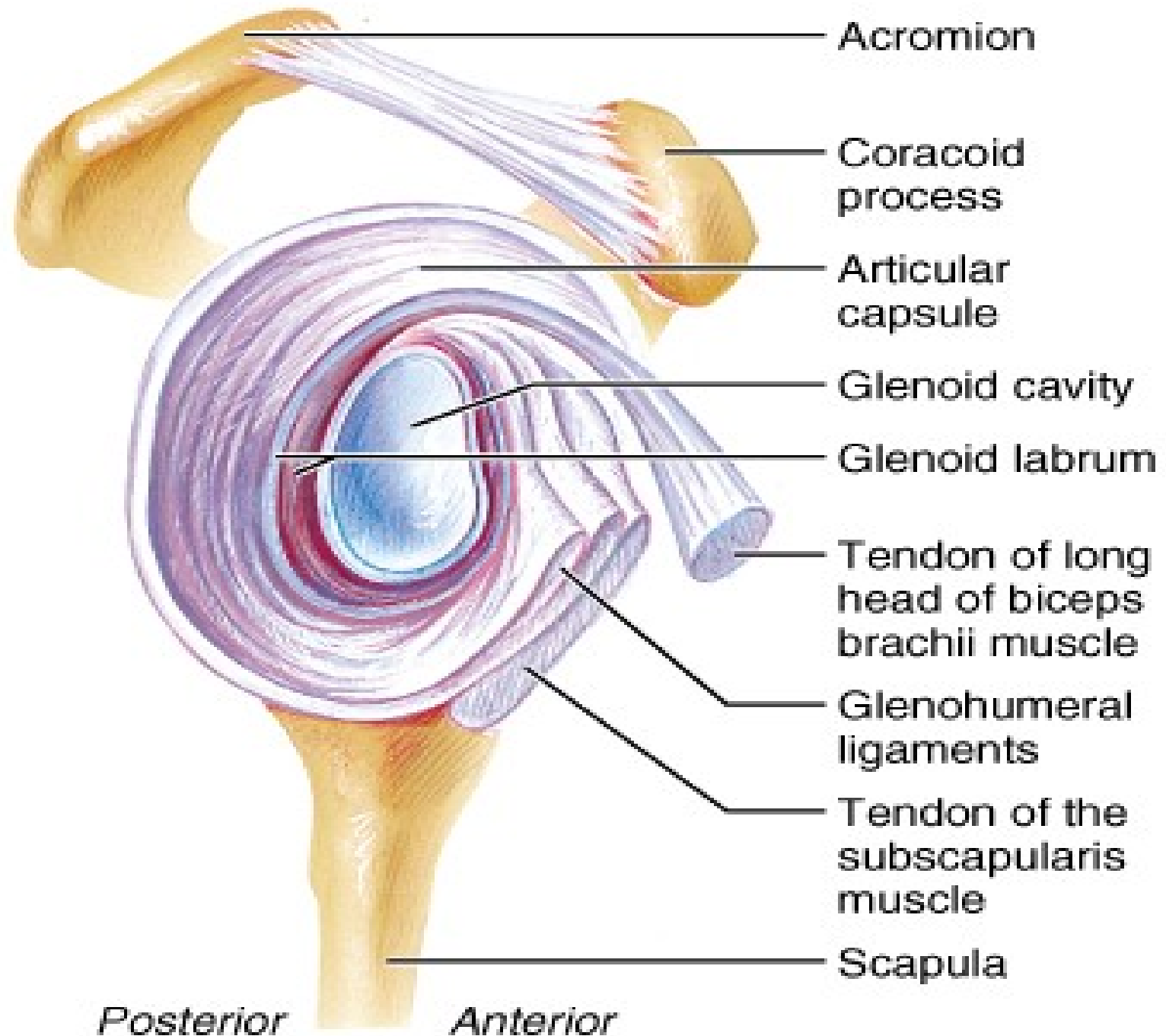
6.64A, B. Rotator cuff and glenohumeral joint.



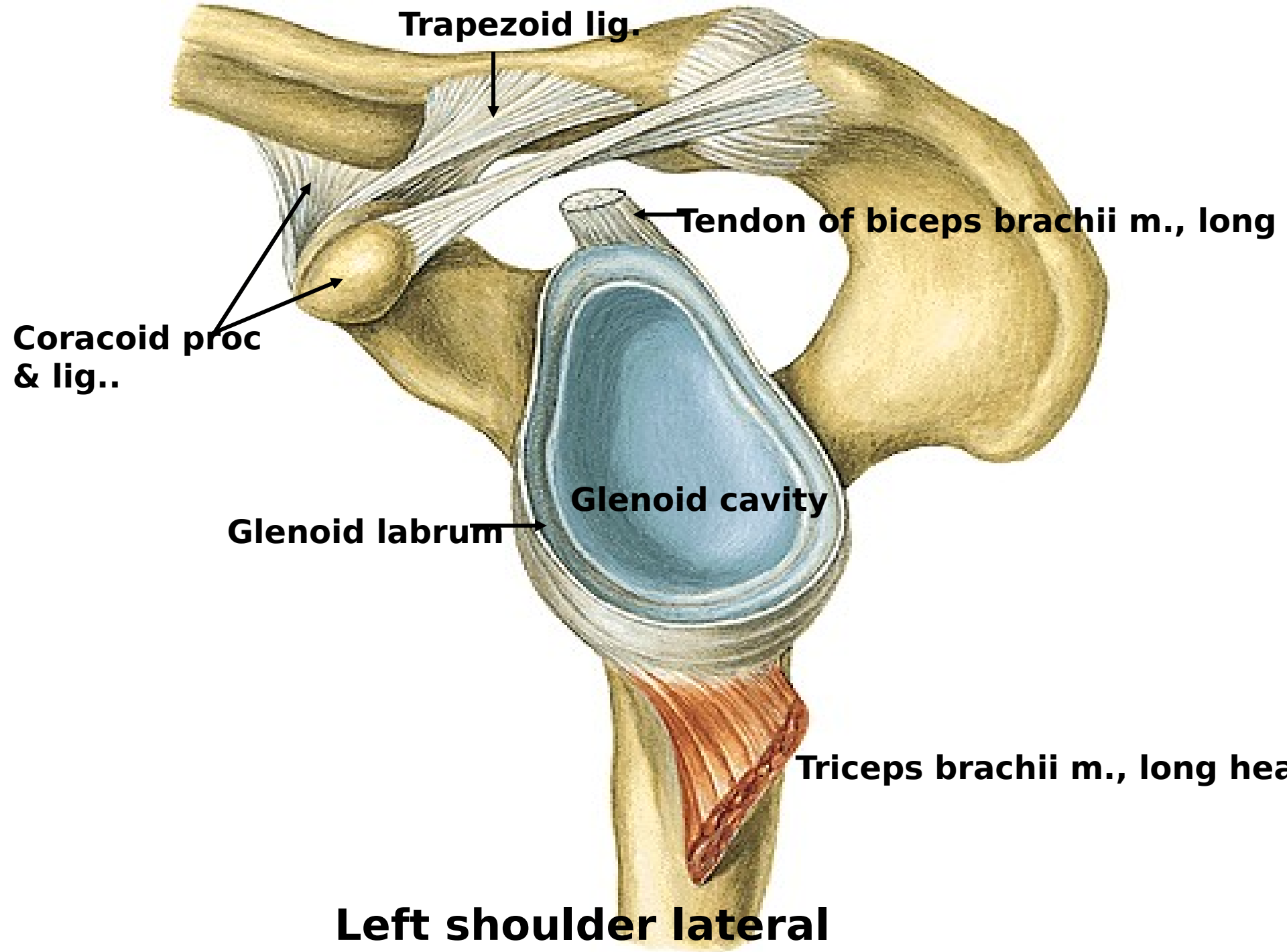
# Shoulder [Glenohumeral] Joint [Opened]

## Lateral View



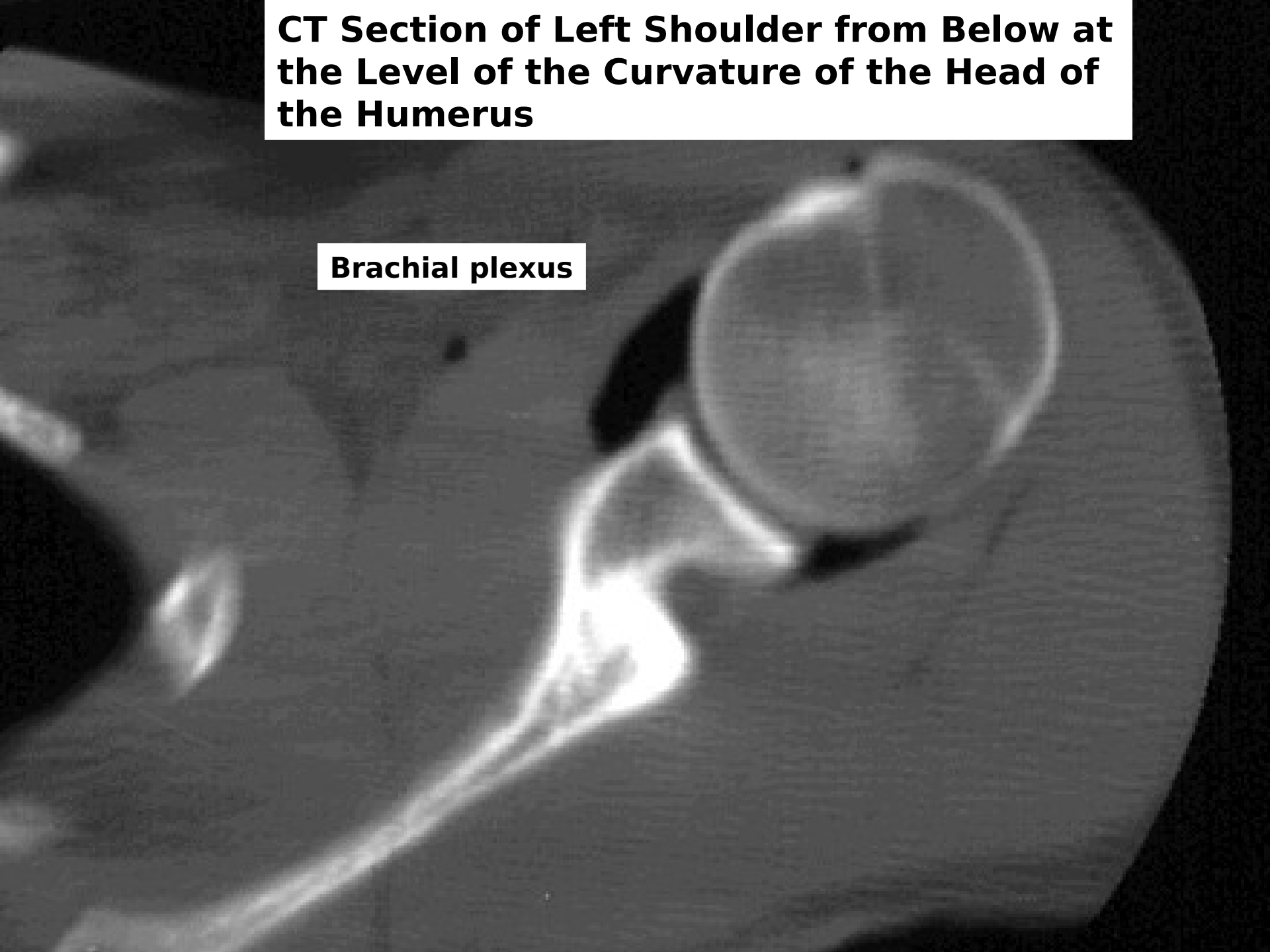






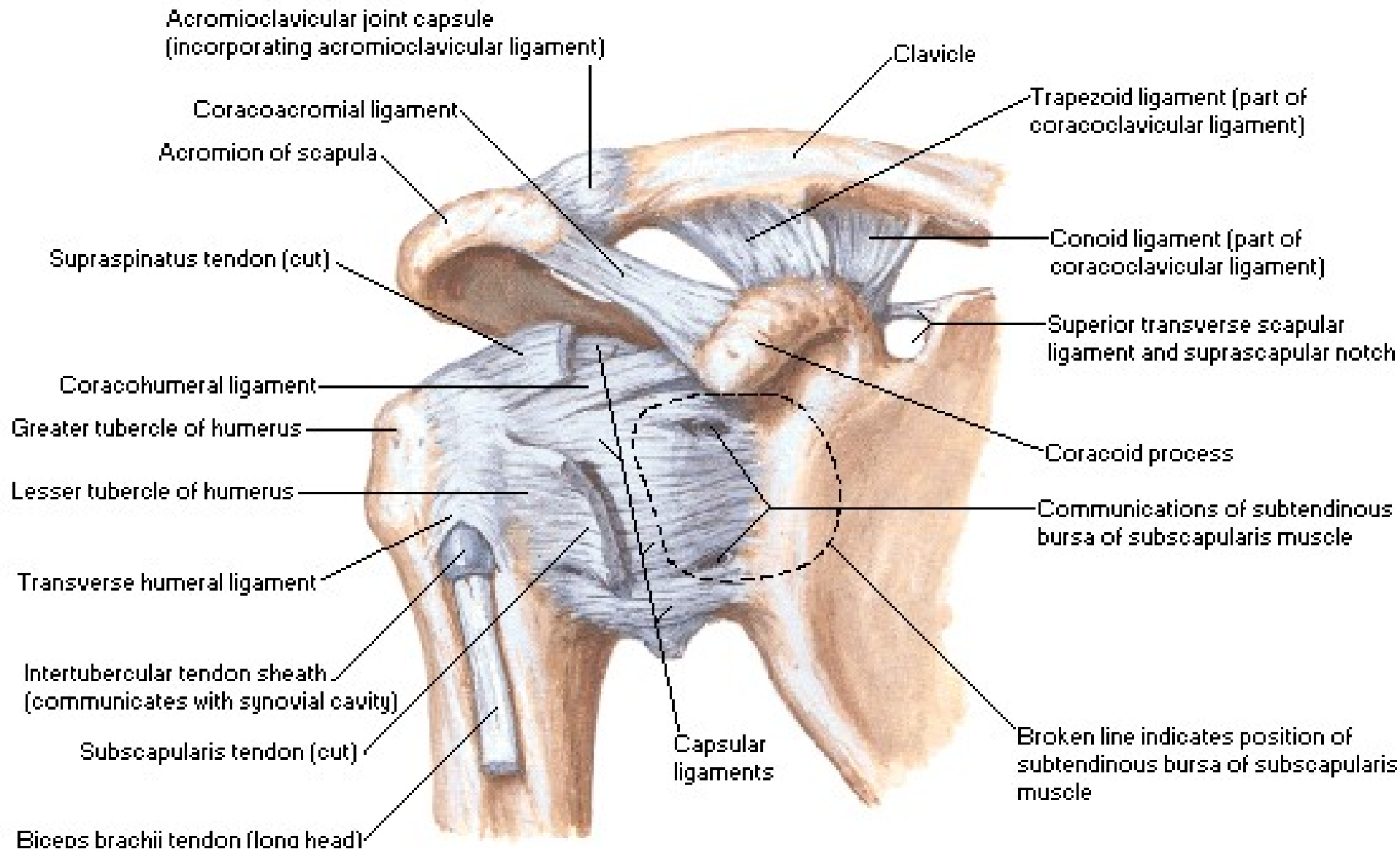
**CT Section of Left Shoulder from Below at  
the Level of the Curvature of the Head of  
the Humerus**

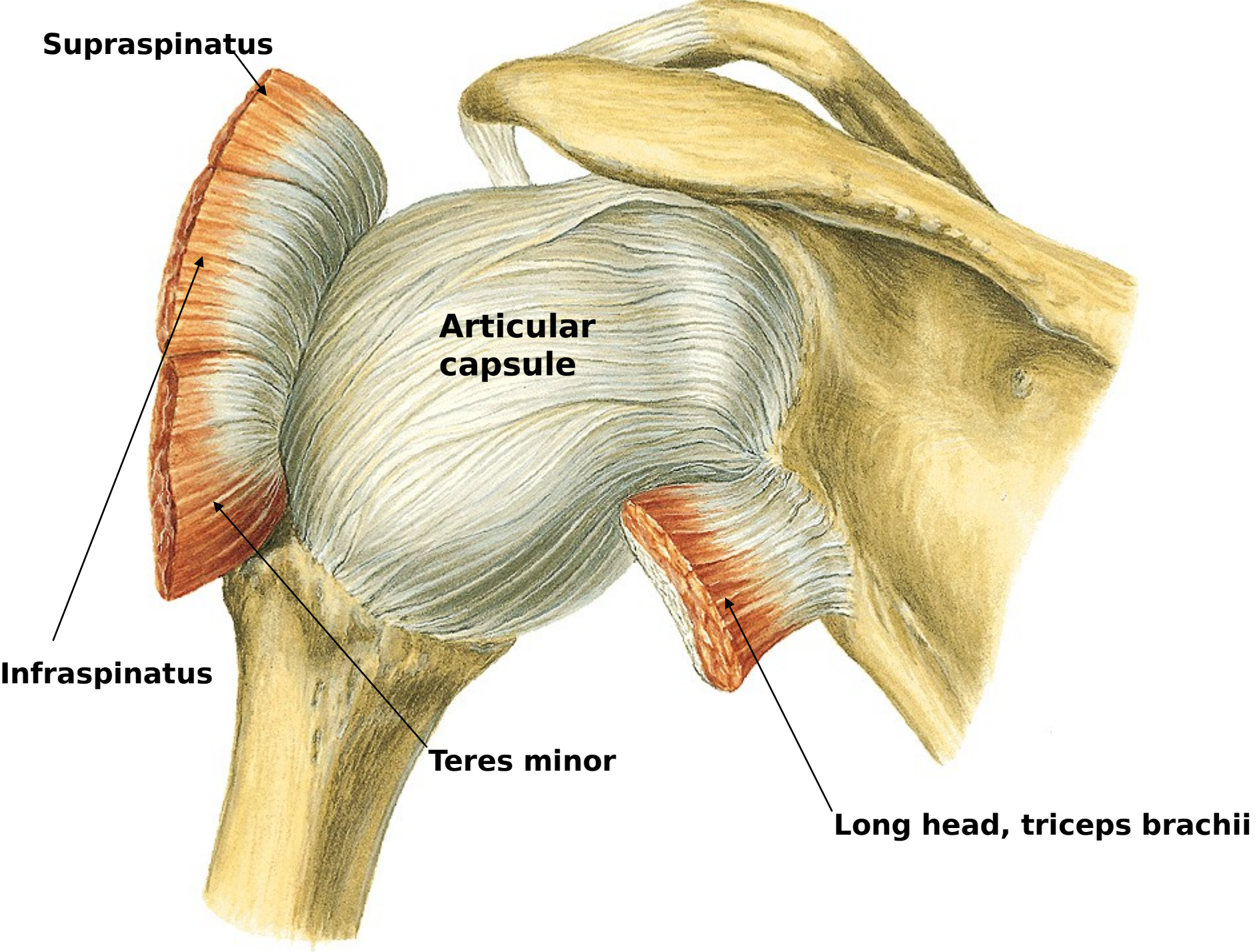
**Brachial plexus**

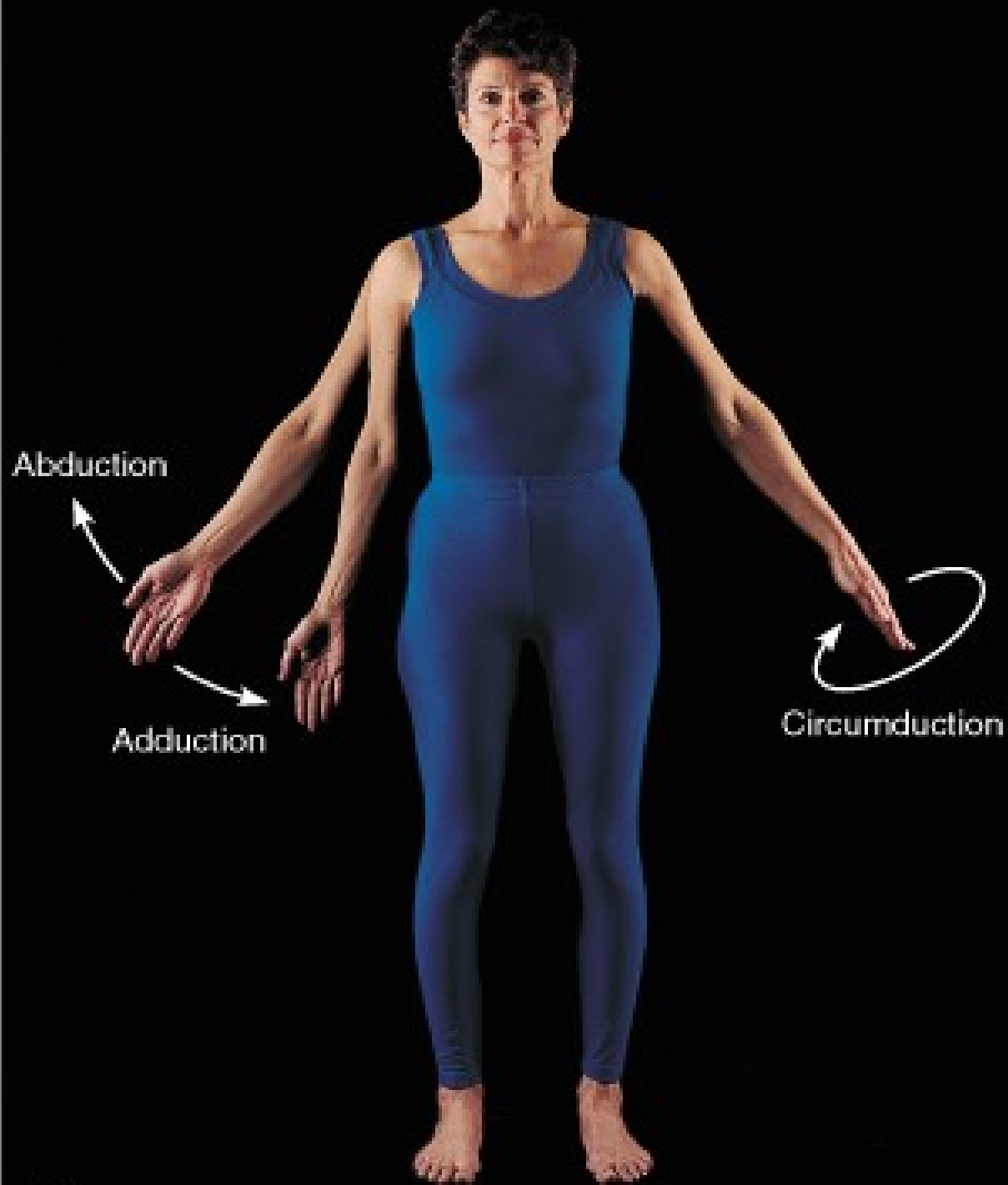


# Shoulder [Glenohumeral] Joint

## Anterior View - Tendons and Ligaments

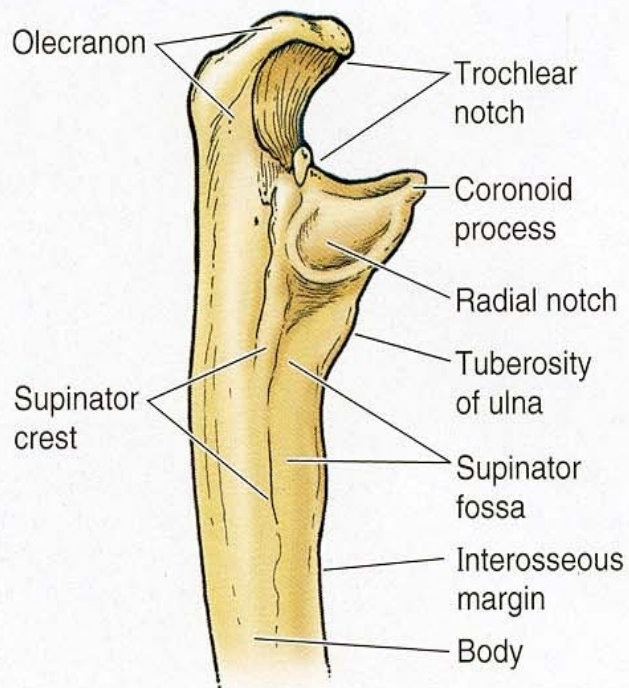




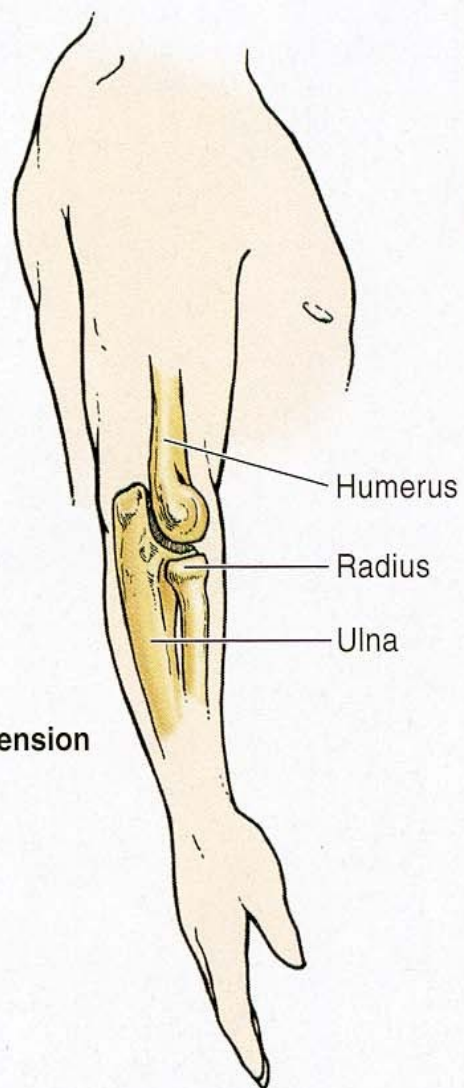


# ELBOW JOINTS

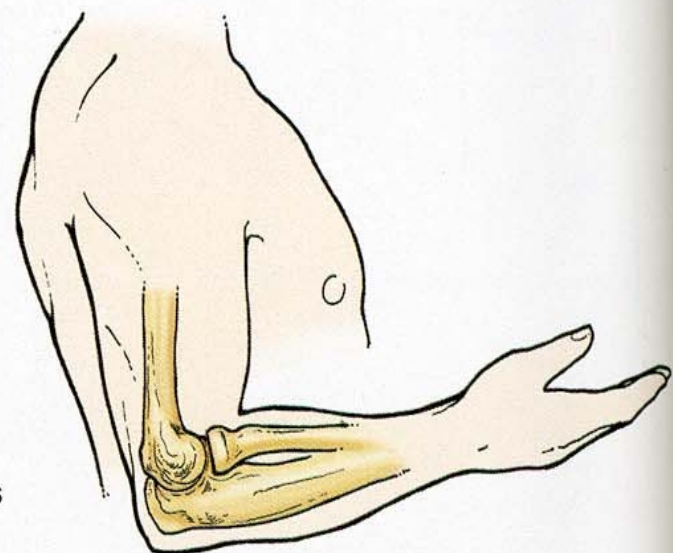




(A)

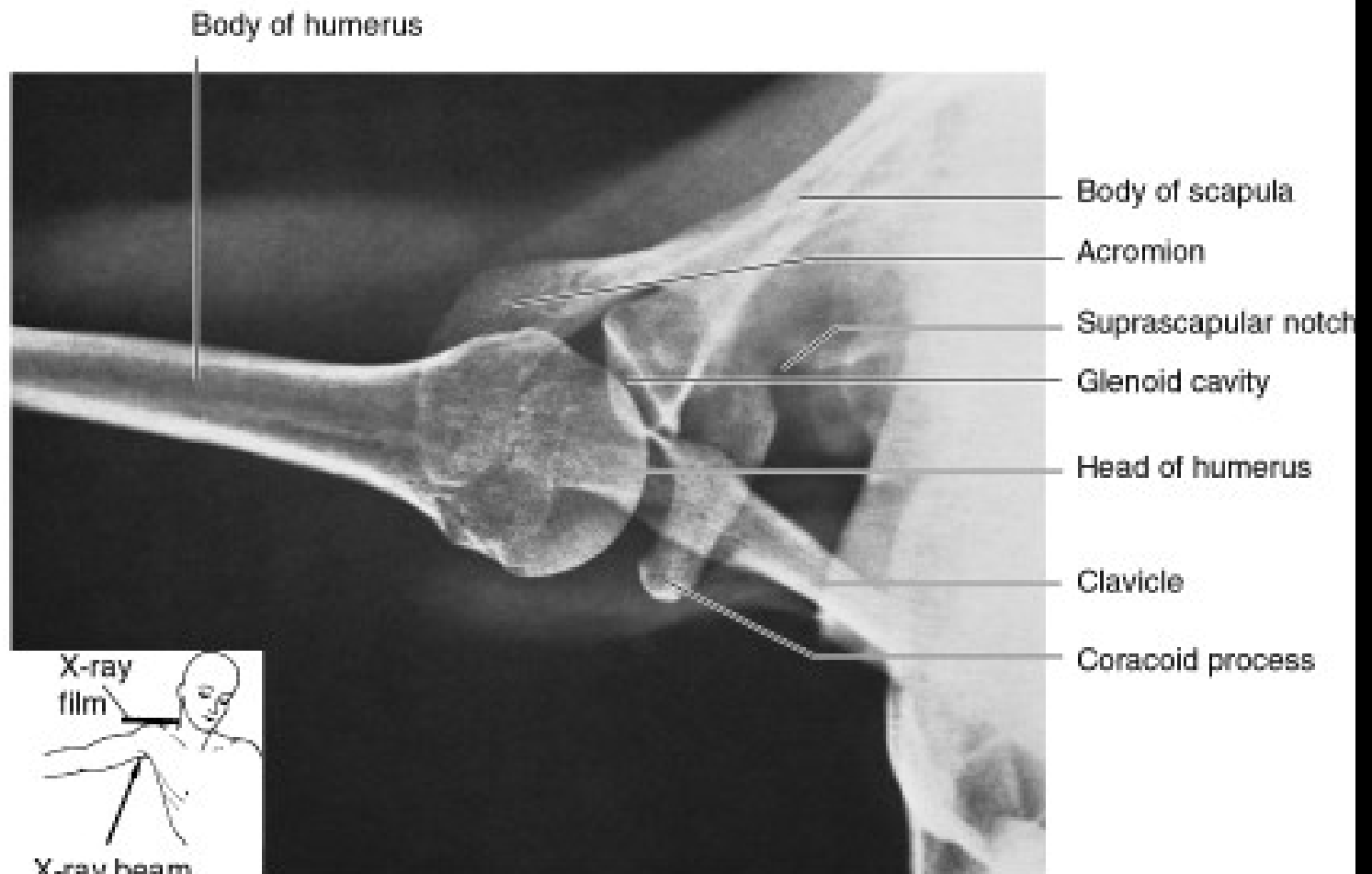


(B) Extension



(C) Flexion

(A) Anteroposterior projection

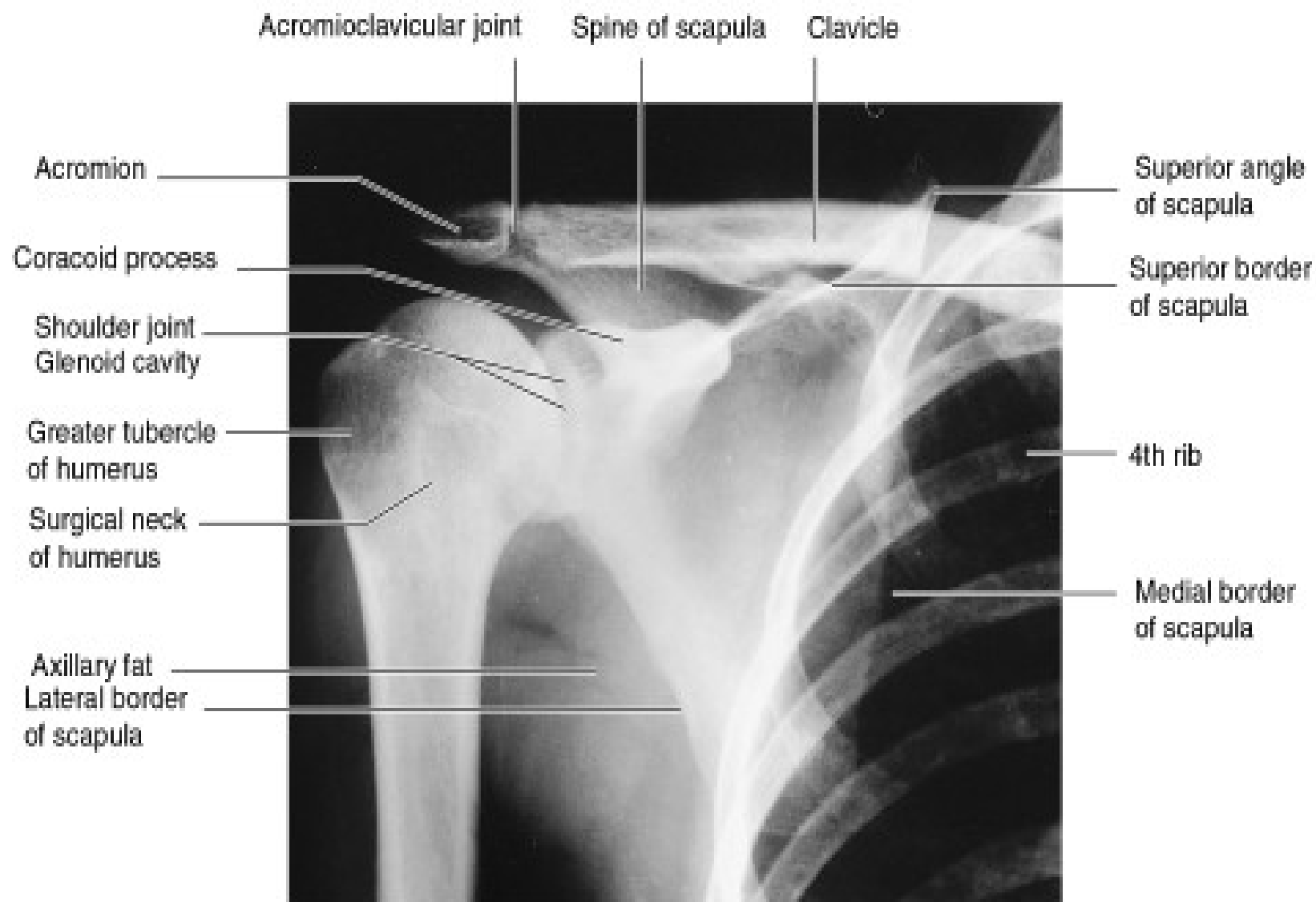


(B) Axial projection

X-ray beam

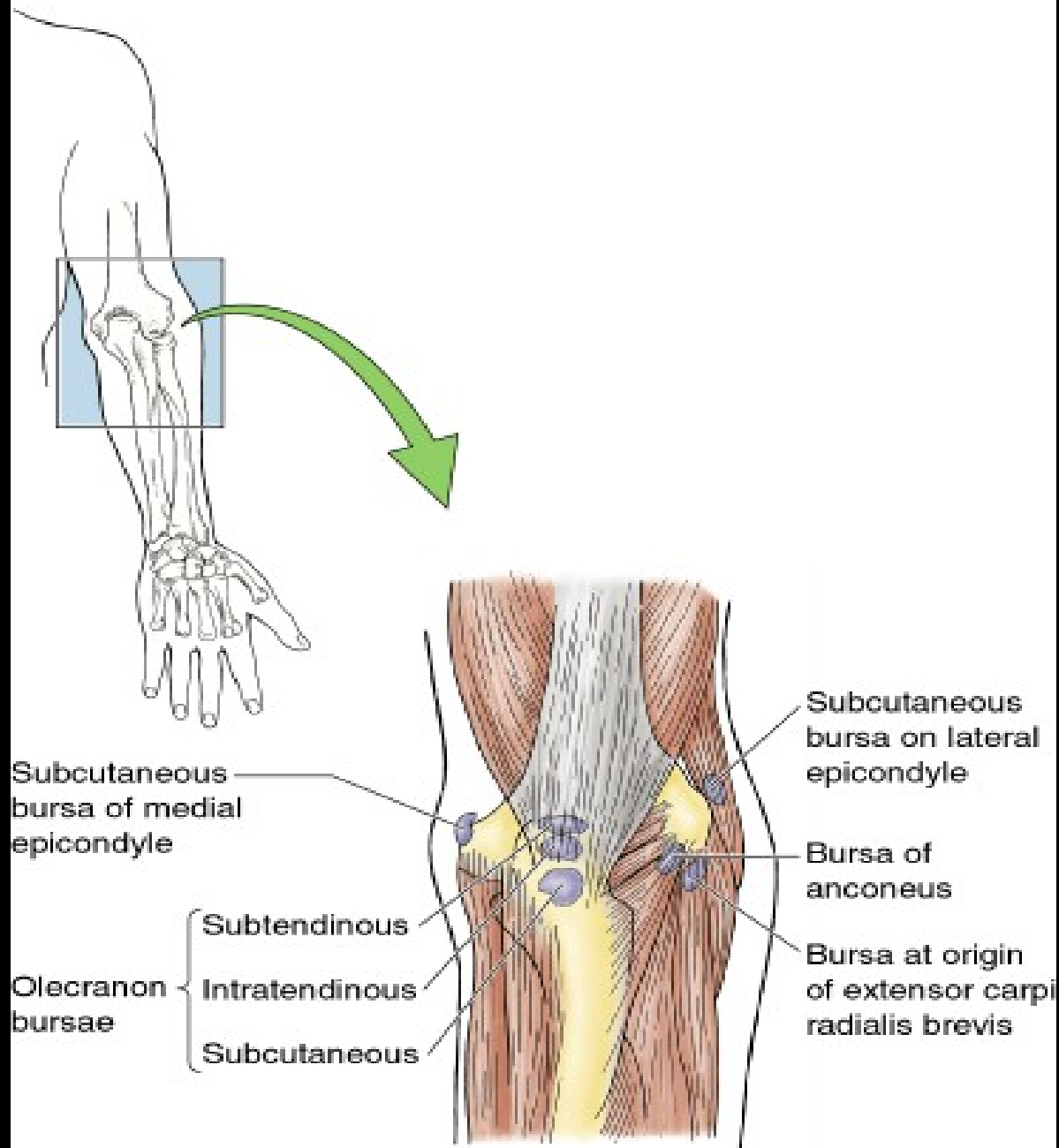


6.78A, B. Radiographs of the glenohumeral joint, AP and axial projections.

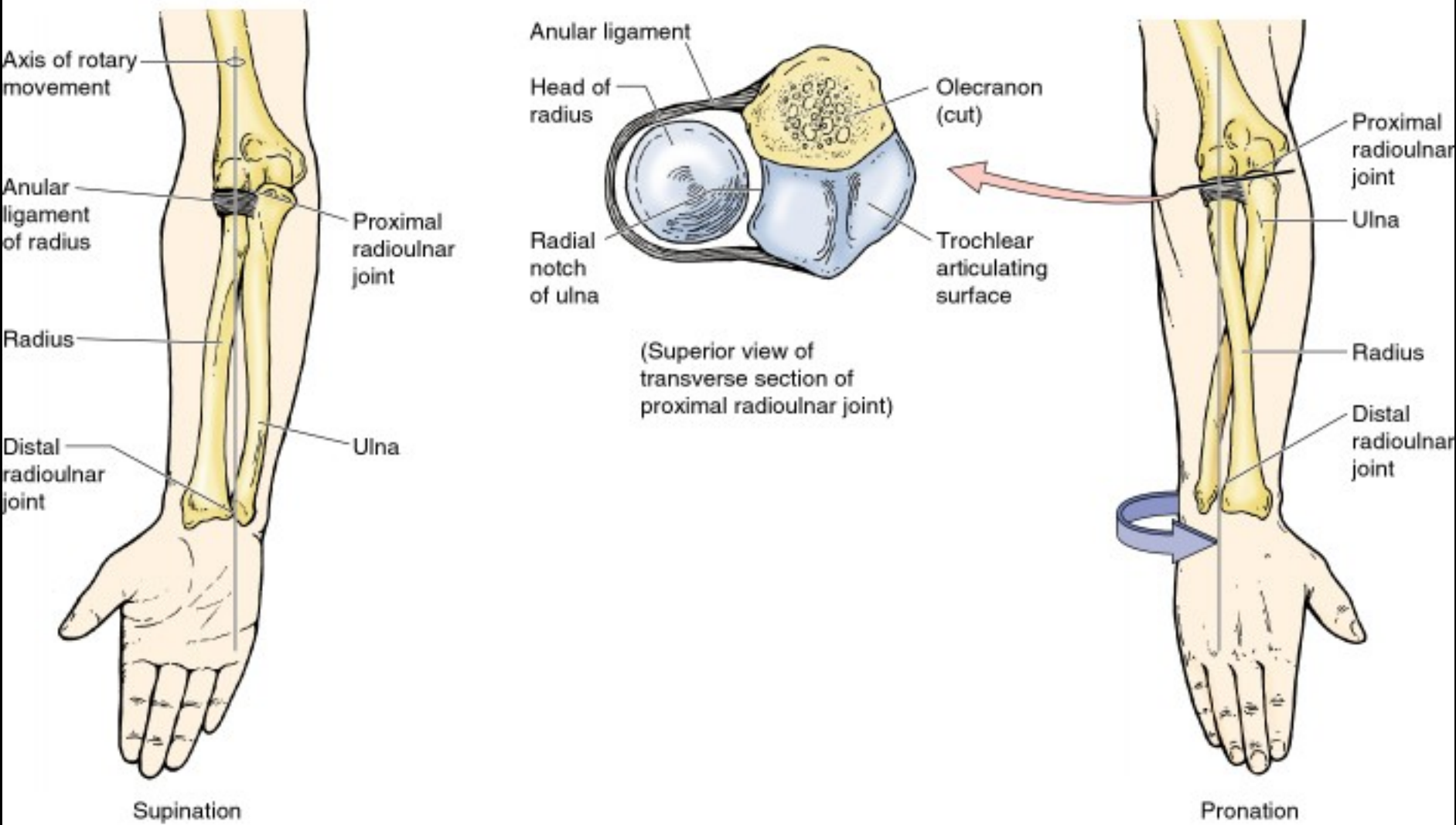


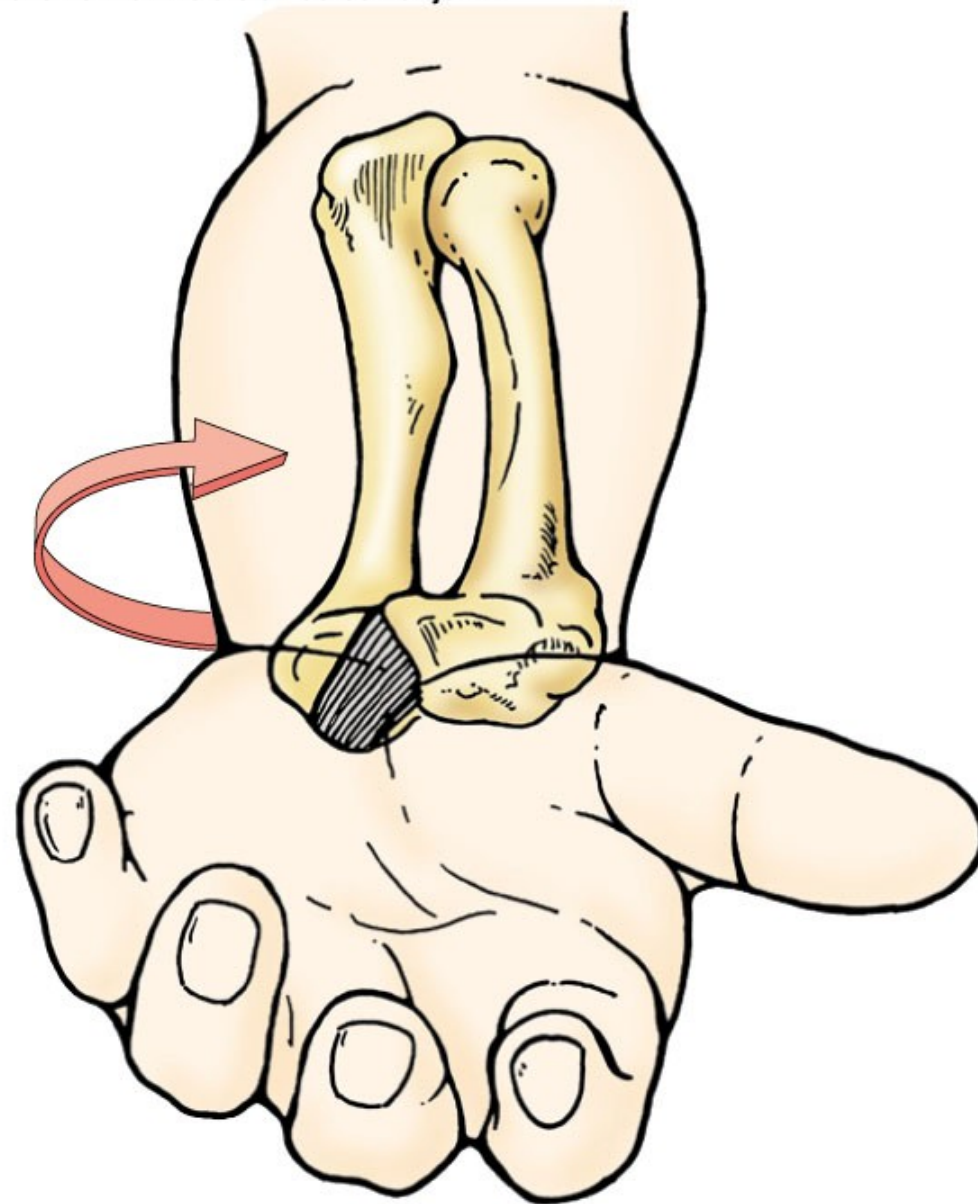
(A) Anteroposterior projection

6.70. Bursae of the elbow joint.



6.72. Supination and pronation of the forearm.





(A)

Supination

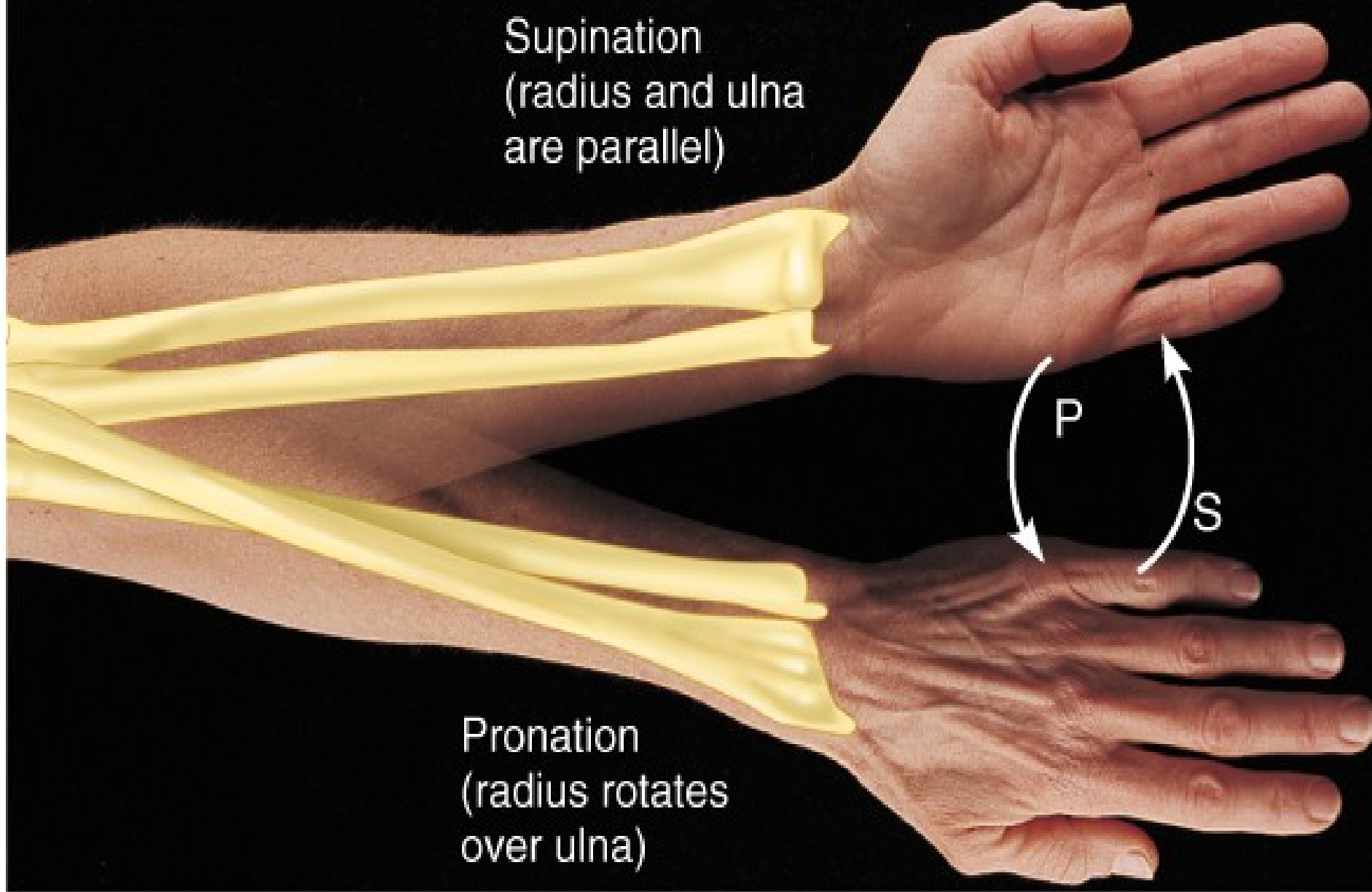
Supination  
(radius and ulna  
are parallel)

Pronation  
(radius rotates  
over ulna)

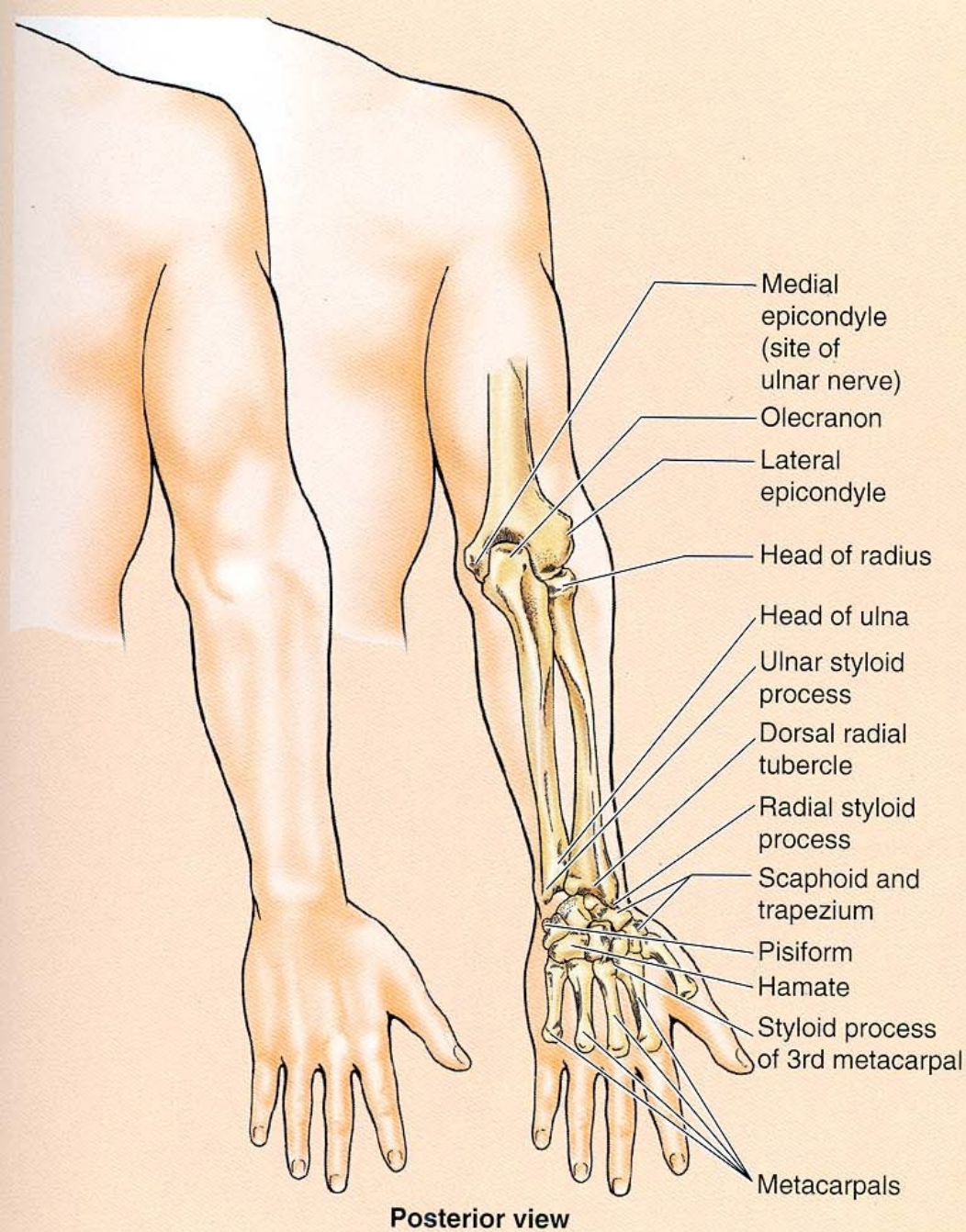
P

S

(a) Supination (S) and pronation (P)





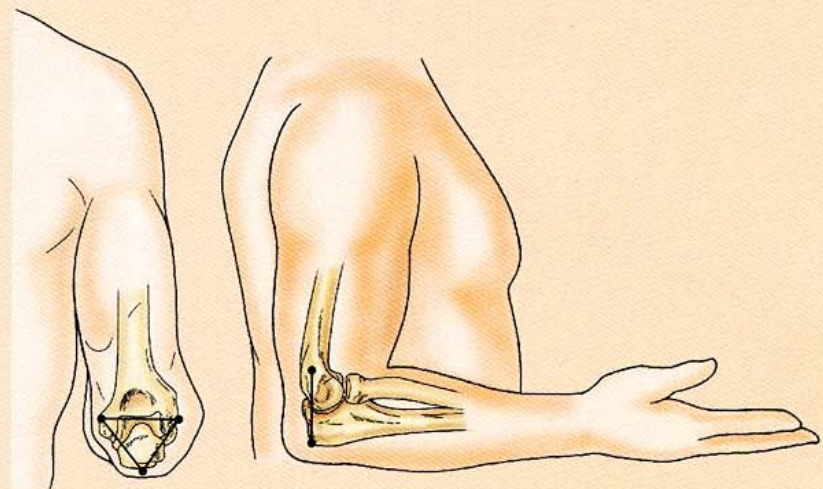


(A)



Posterior view

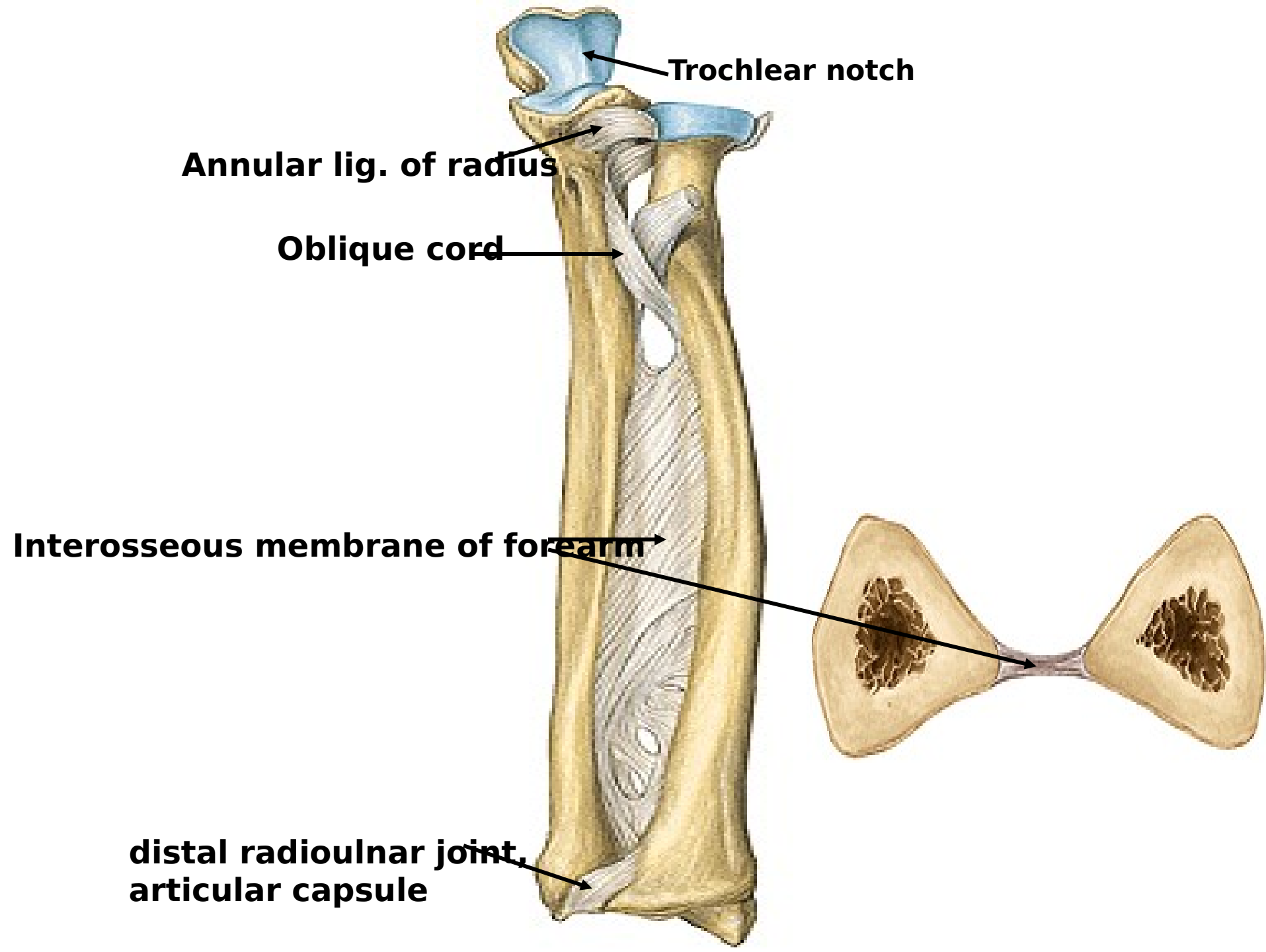
(B) Extension: condyles and olecranon aligned during extension

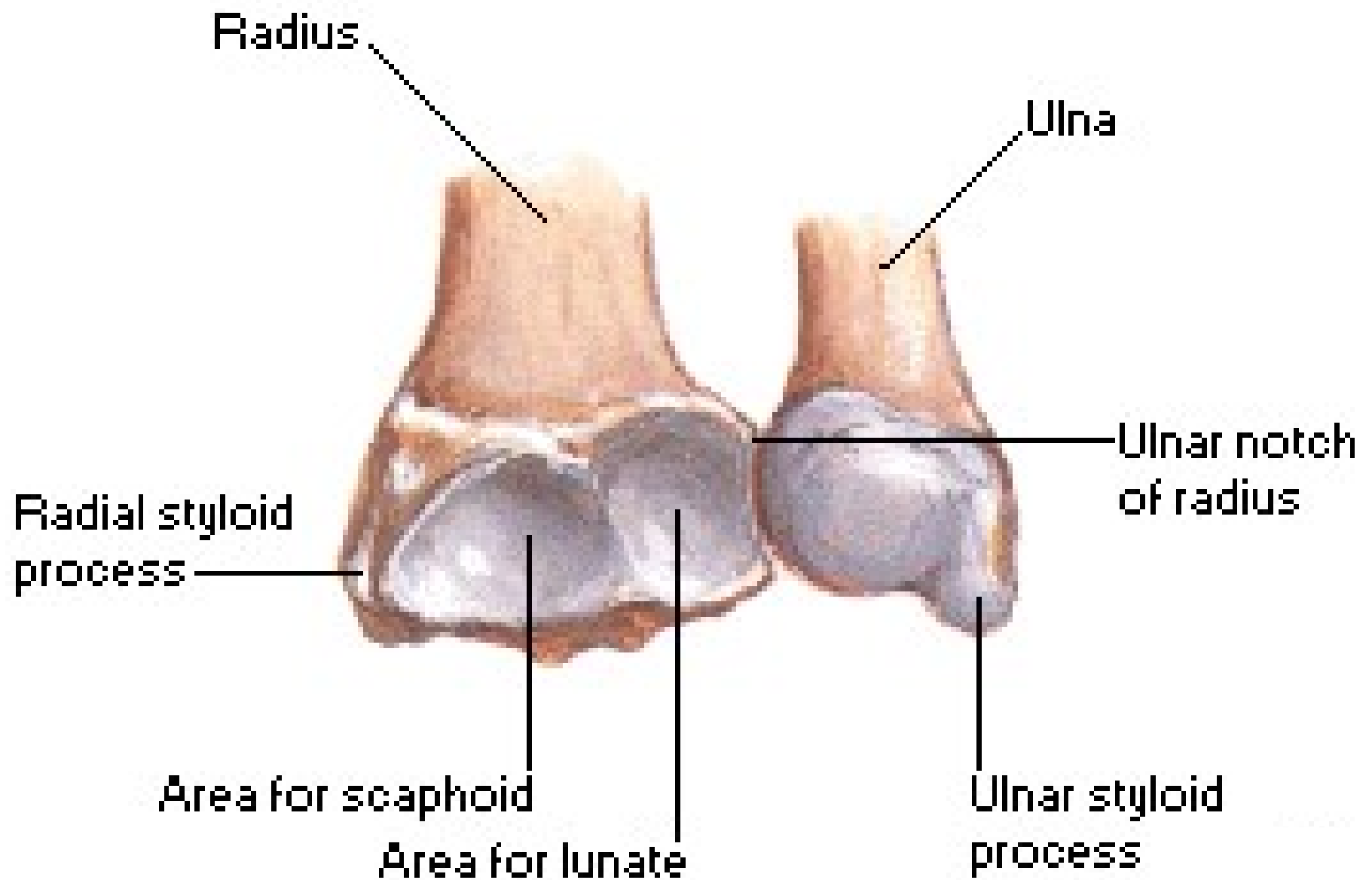


Posterior view

Lateral view

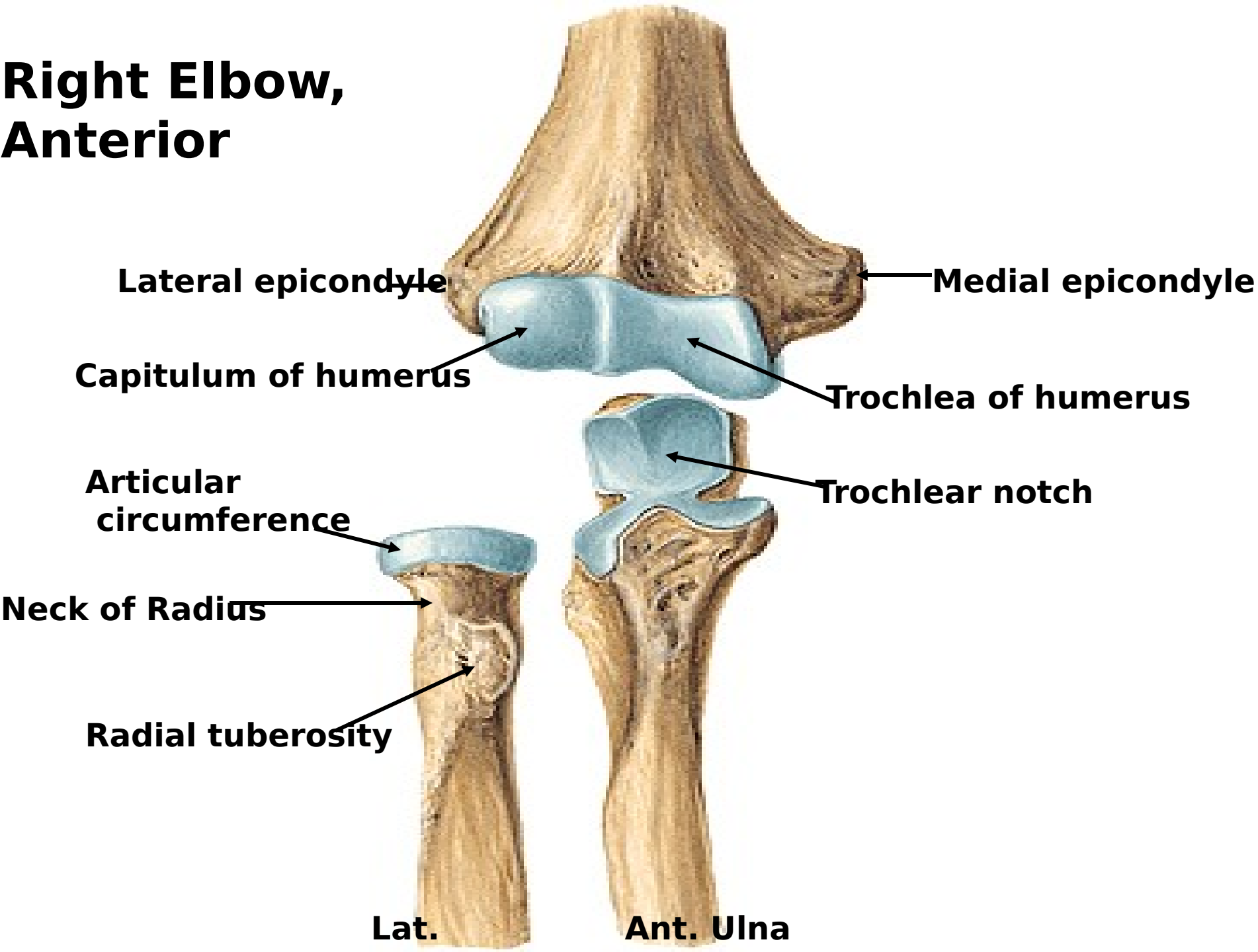
(C) Flexion: condyles form triangle and align vertically with olecranon during flexion

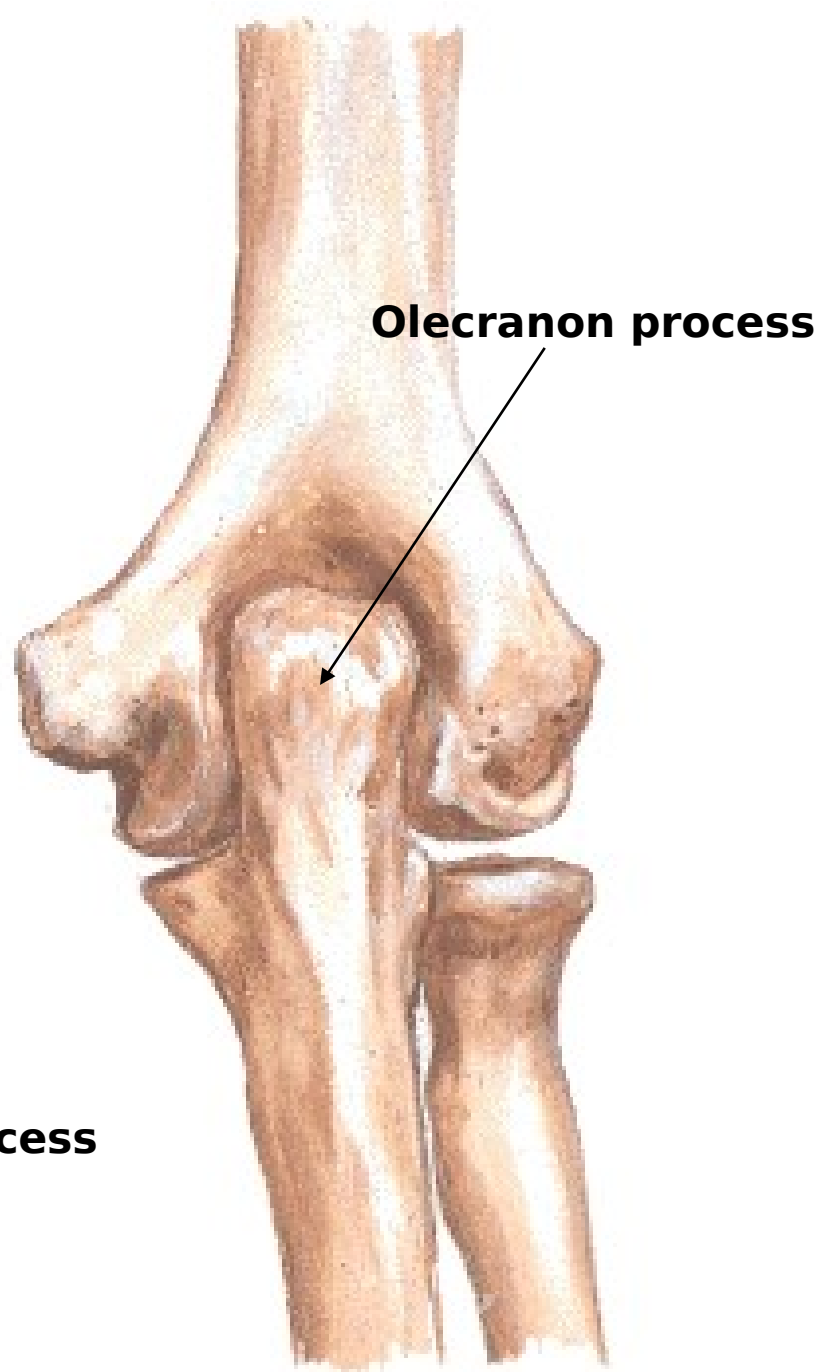
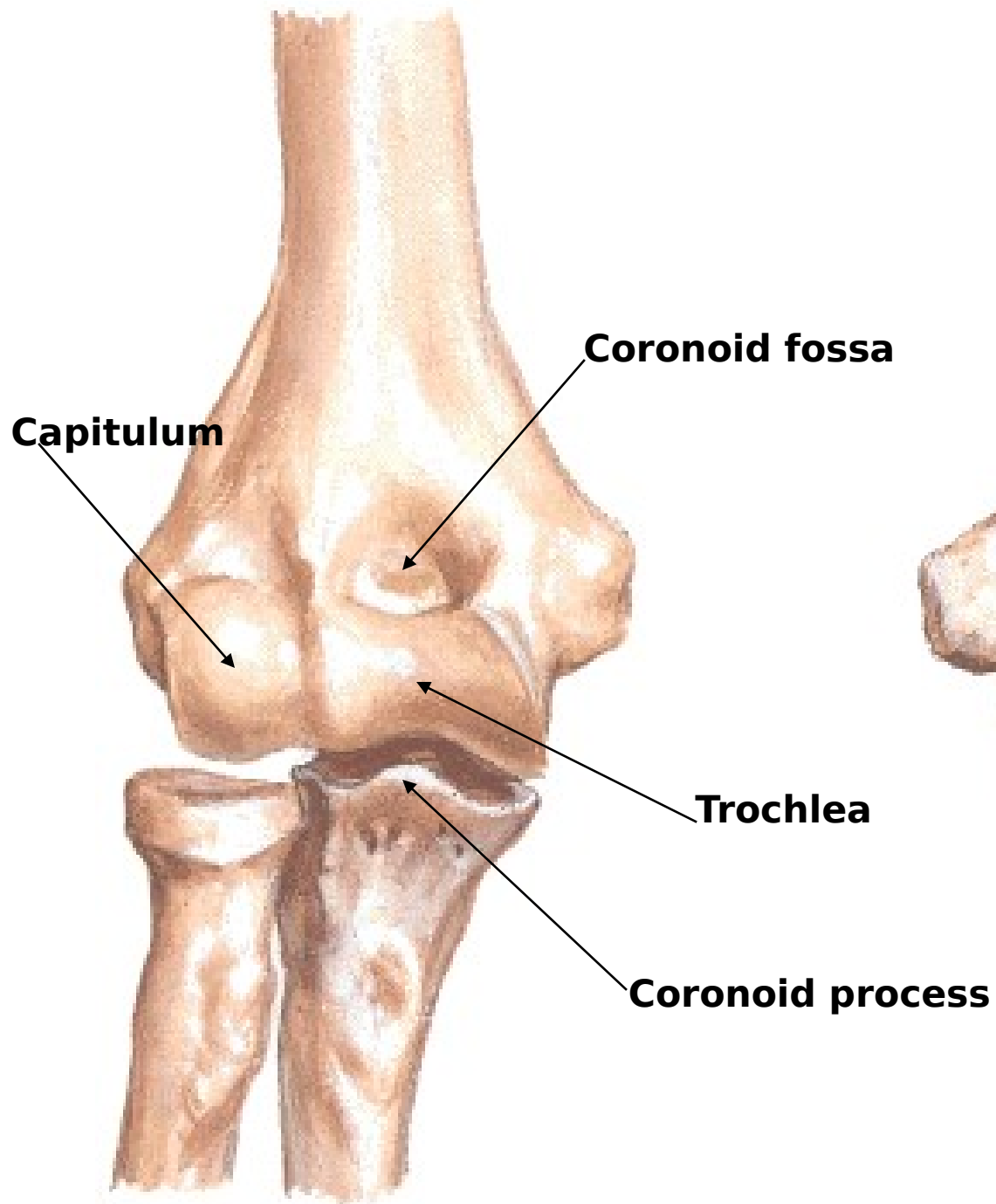




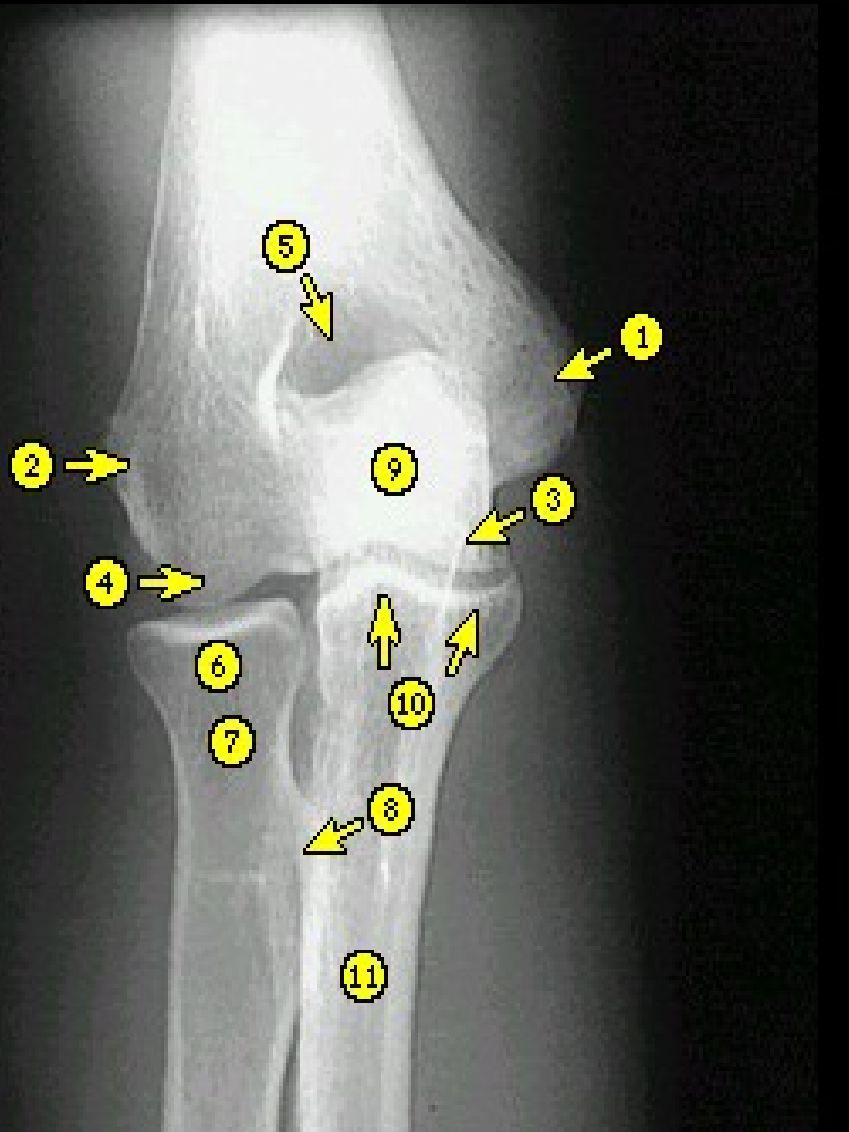


# Right Elbow, Anterior



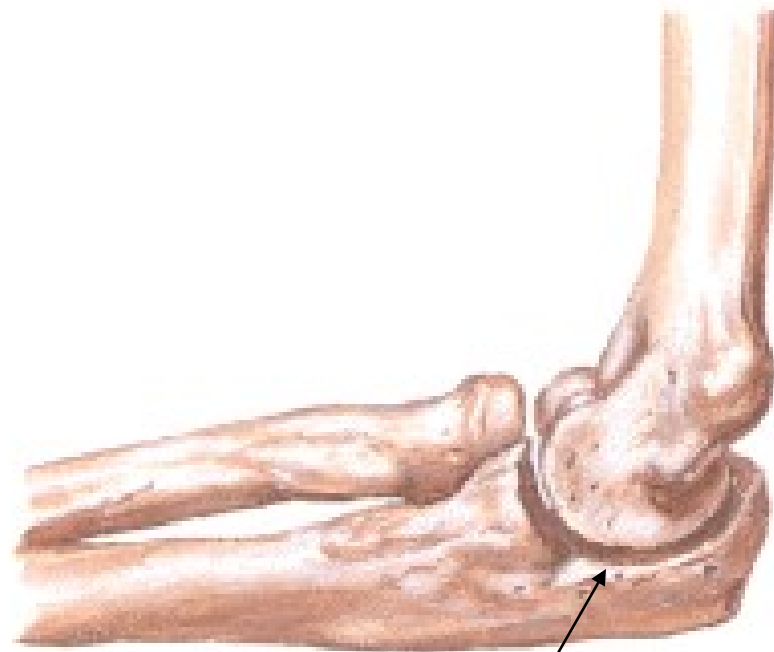


## AP Elbow



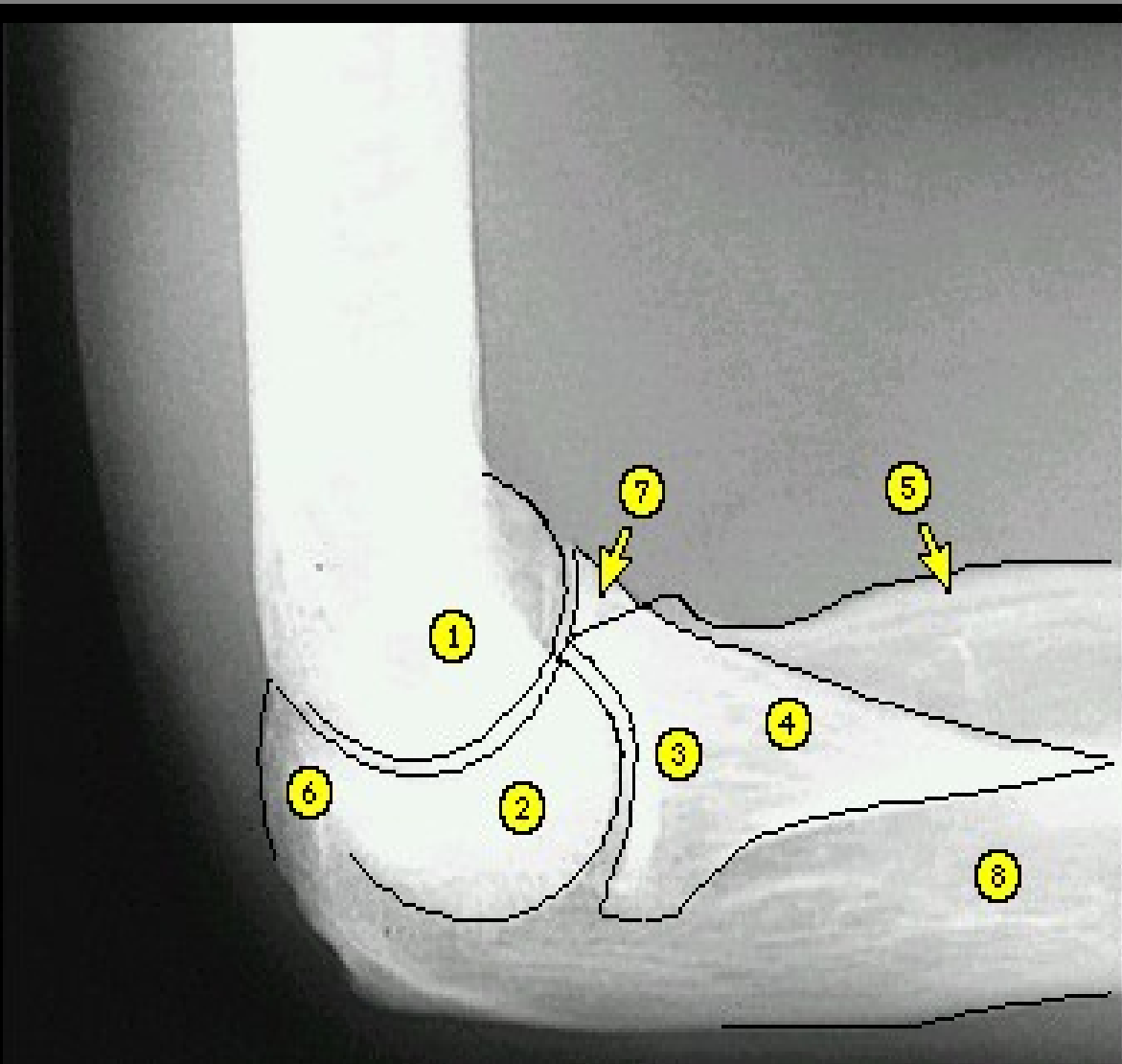
## Bones and Joints

- 1-medial epicondyle of humerus
- 2-lateral epicondyle of humerus
- 3-trochlea of humerus
- 4-capitulum of humerus
- 5-olecranon fossa of humerus
- 6-head of radius
- 7-neck of radius
- 8-radial tuberosity
- 9-olecranon of ulna
- 10-coronoid process of ulna
- 11-shaft of ulna



**Trochlear notch**

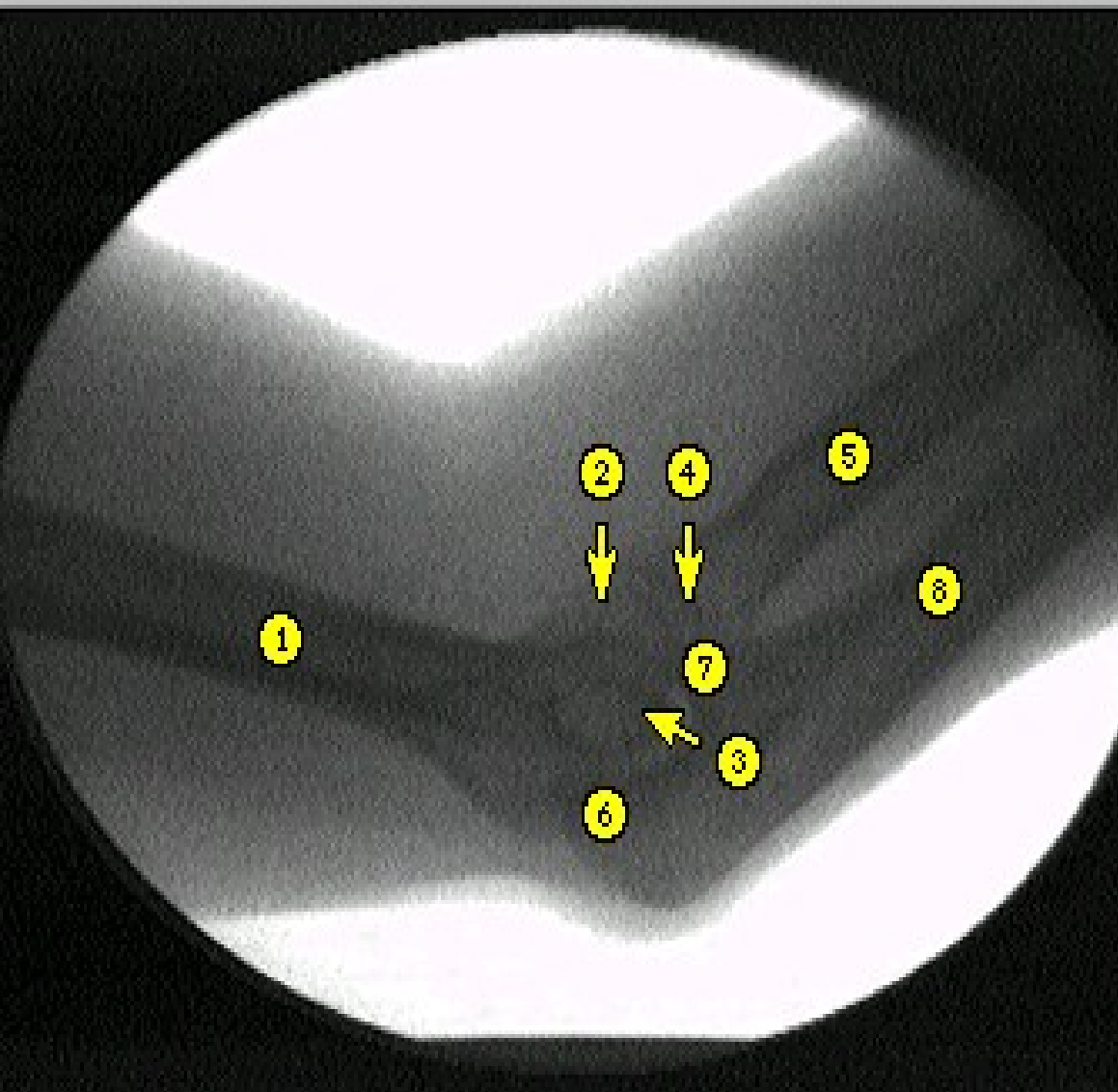
## Lateral Elbow



## Bones and Joints

- 1-trochlea of humerus
- 2-capitulum of humerus
- 3-head of radius
- 4-neck of radius
- 5-radial tuberosity
- 6-olecranon of ulna
- 7-coronoid process of ulna
- 8-shaft of ulna

## Fluoroscopy, Elbow

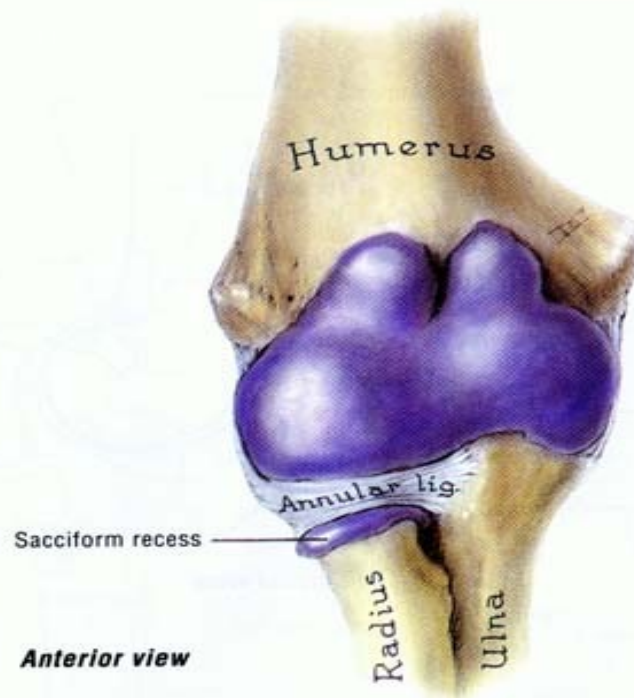


## Bones and Joints

- 1-shaft of humerus
- 2-capitulum of humerus
- 3-trochlea of humerus
- 4-head of radius
- 5-shaft of radius
- 6-olecranon of ulna
- 7-coronoid process of ulna
- 8-shaft of ulna

# Upper Limb - Articulations

<u>Joint</u>	<u>Type of Joint</u>	<u>Movement</u>
<b>Elbow joint</b>		<b>Flexion, Extension</b>
a) Humeroulnar	<b>Hinge</b>	<b>Flexion, Extension,</b>
b) Humeroradial	<b>Ball &amp; Socket -</b>	<b>Rotation</b>
	<b>restricted</b>	<b>Pronation, Supination</b>
c) Radioulnar	<b>Pivot</b>	



**Anterior view**

## 6.72

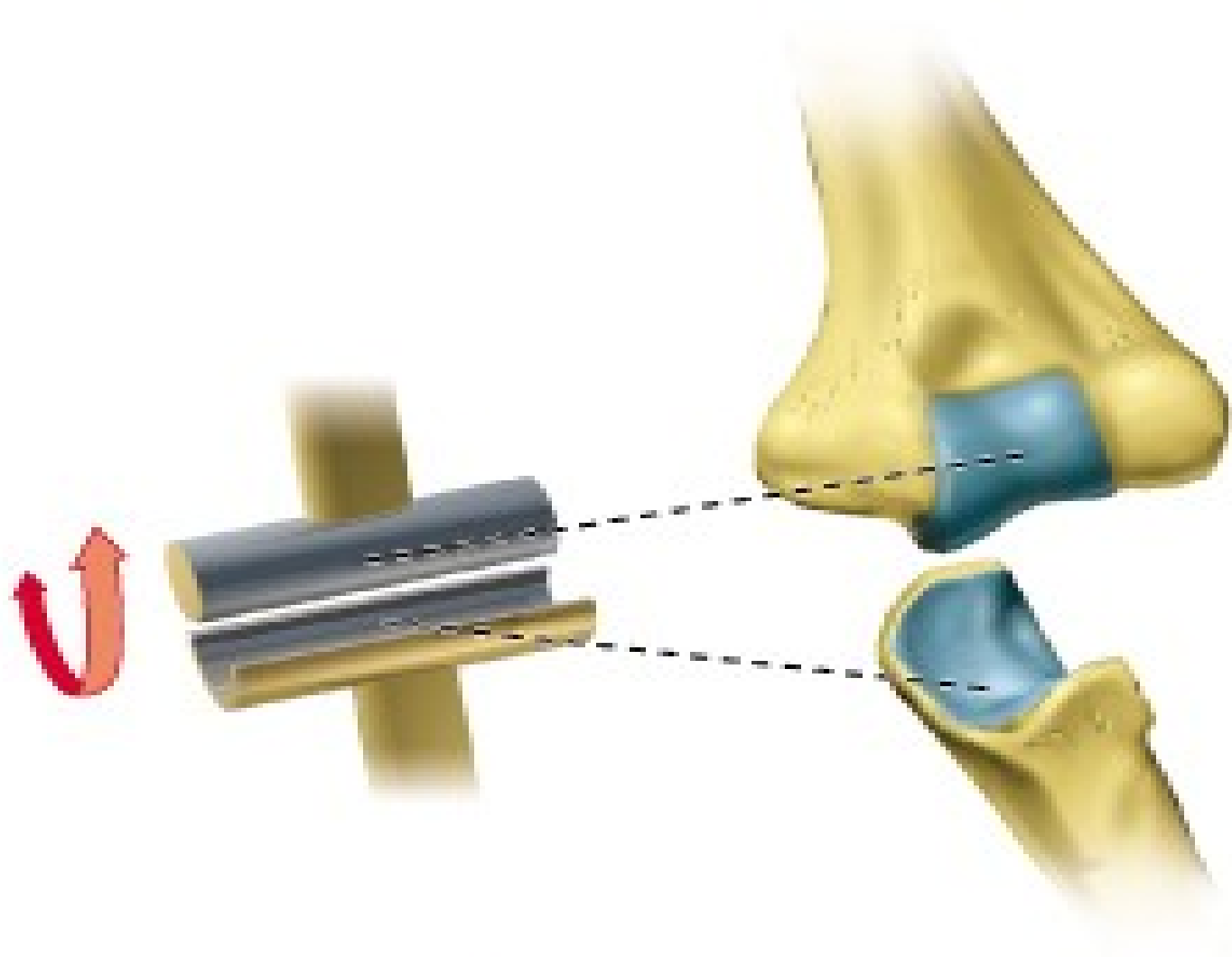
### Articular cavity of the elbow and proximal radioulnar joints

The cavity of the elbow was injected with wax. The fibrous capsule has been removed; the synovial capsule remains.



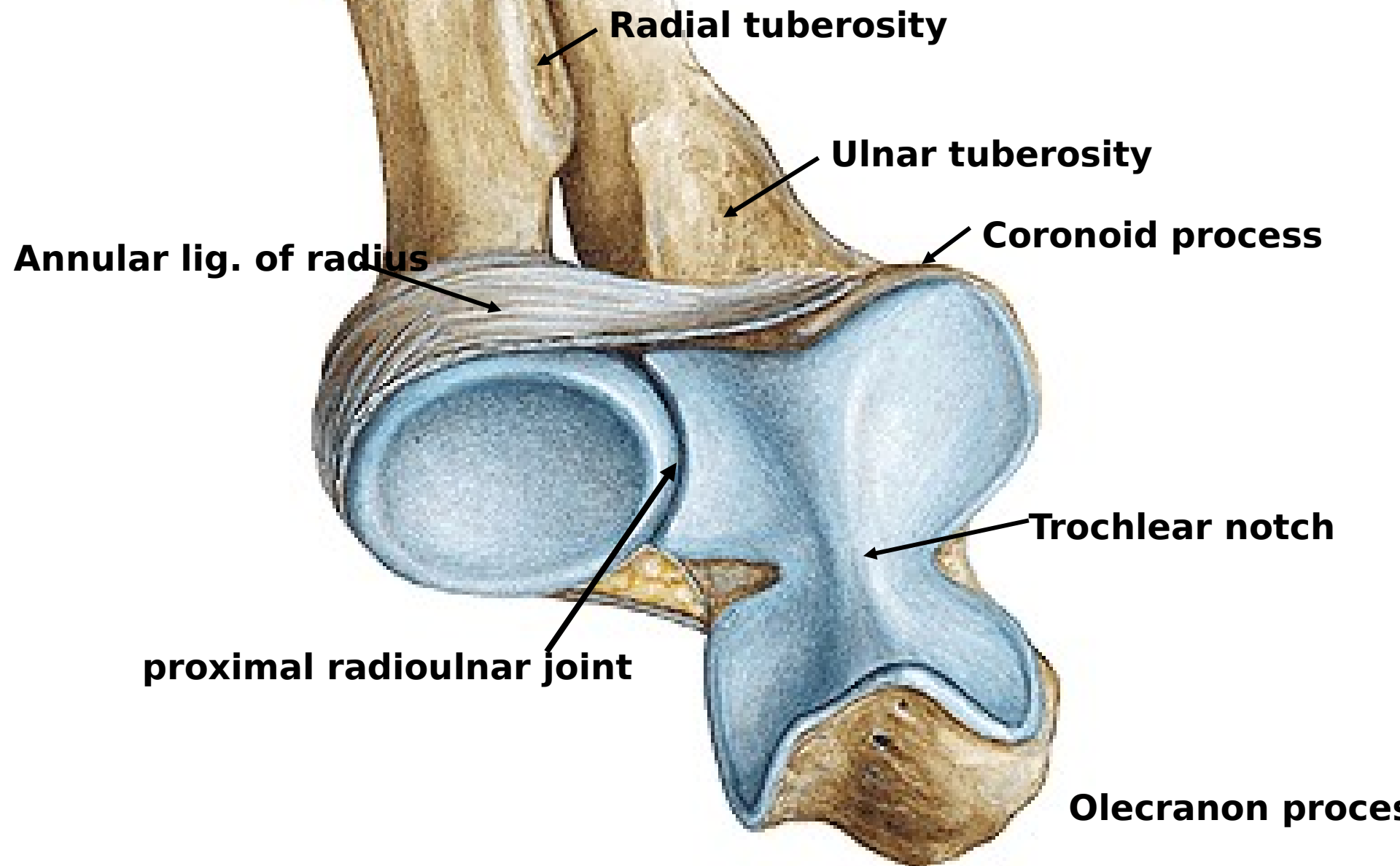
**Superior view**

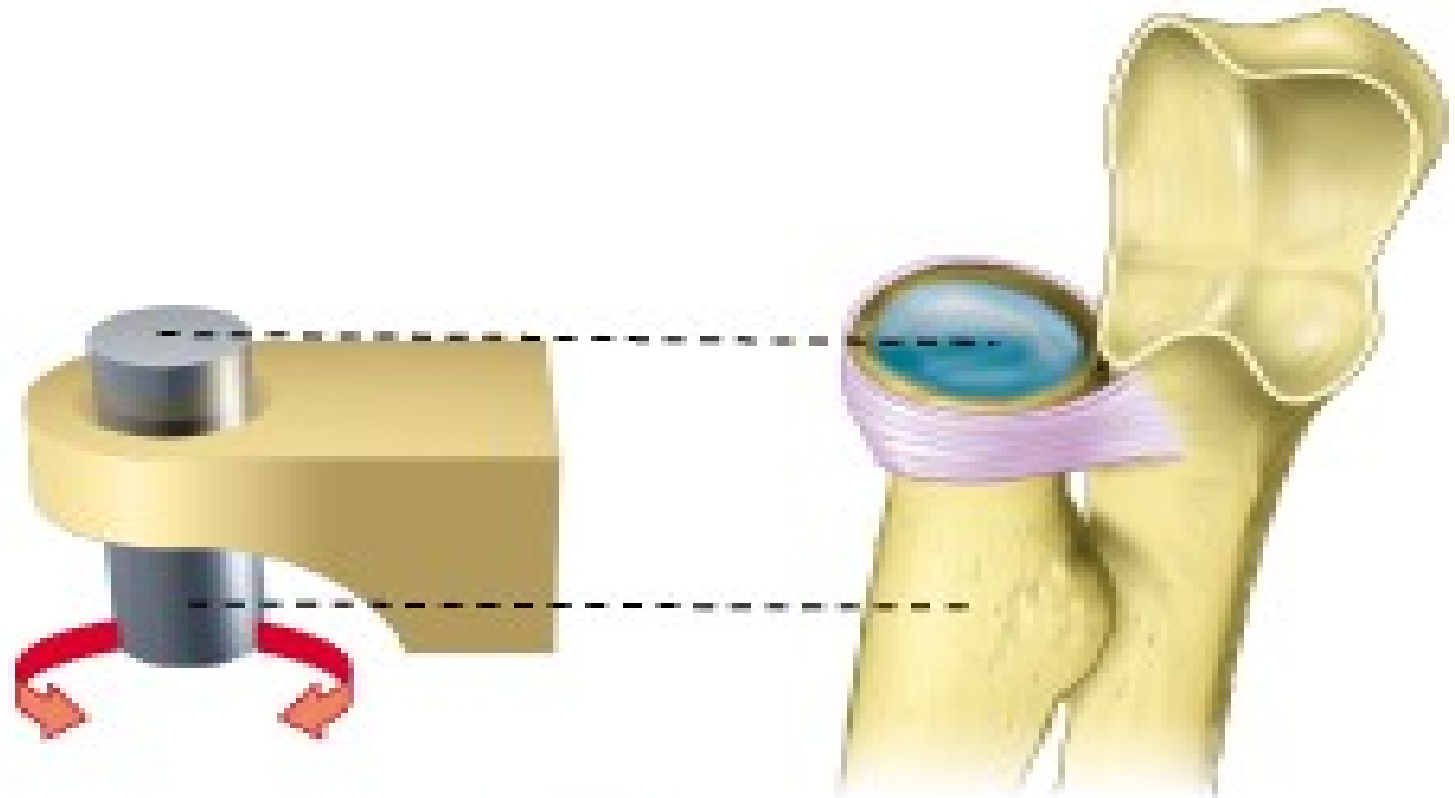




**b** Hinge joint

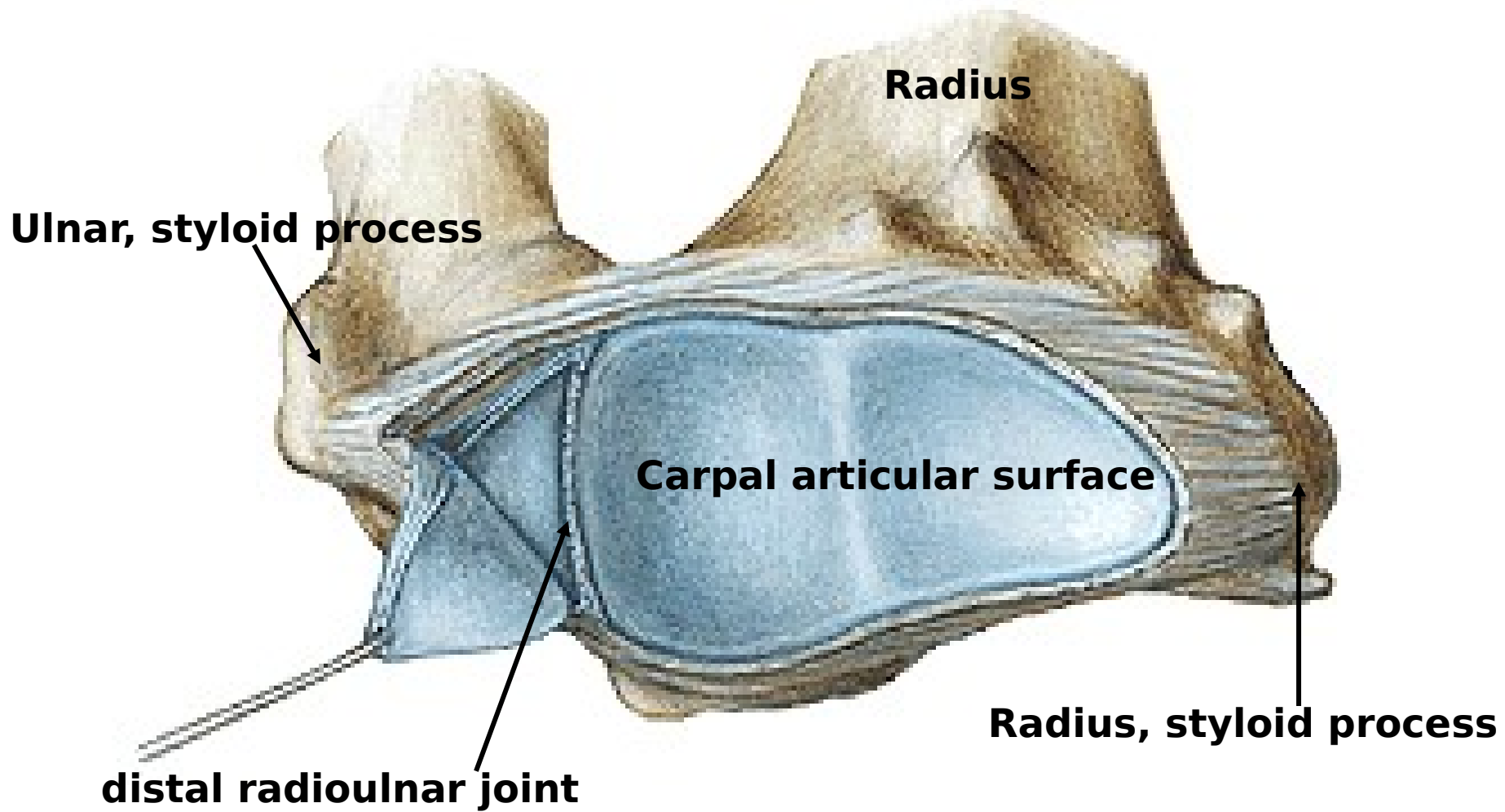
# Radioulnar Joint, Anterior



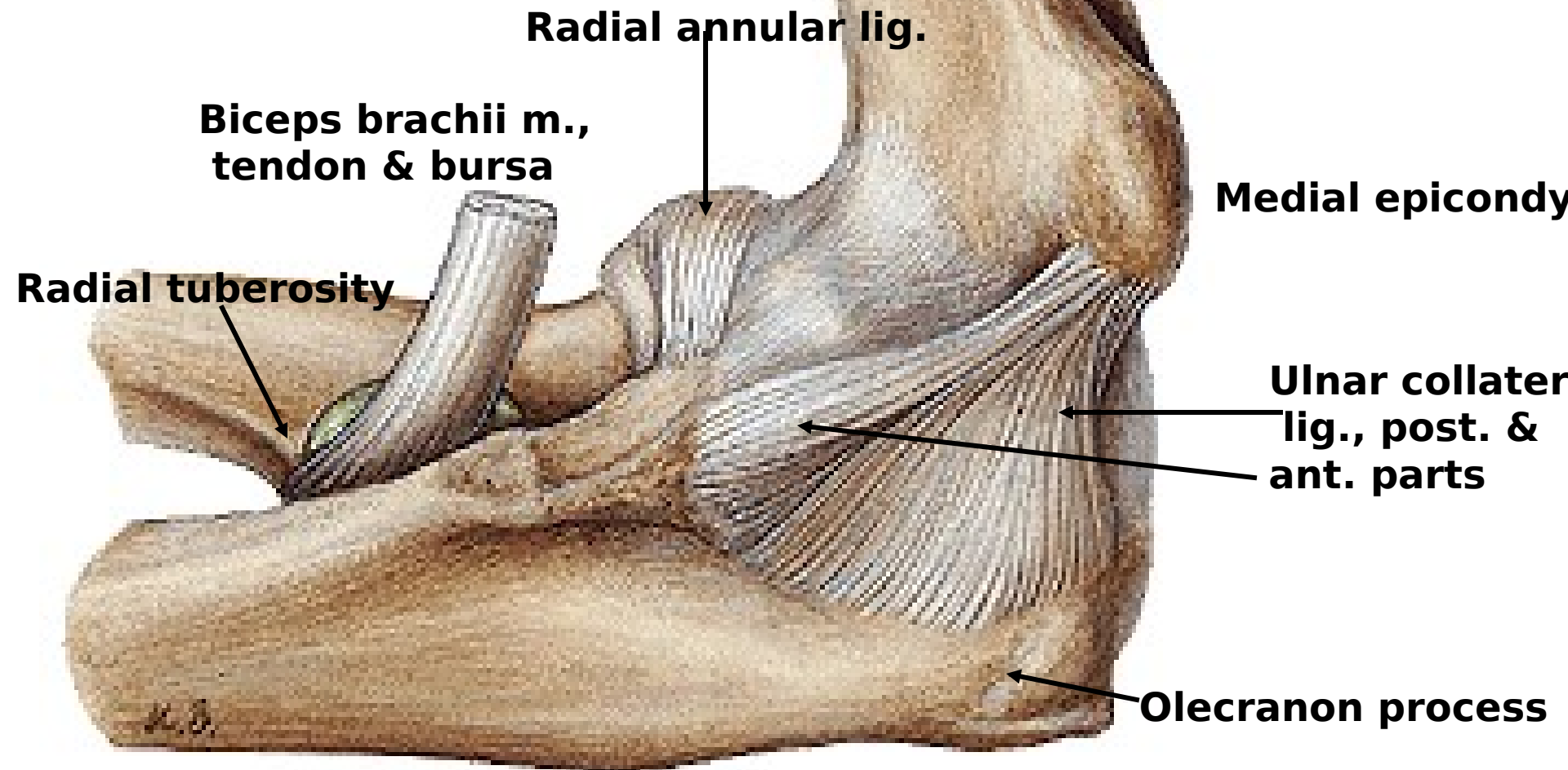


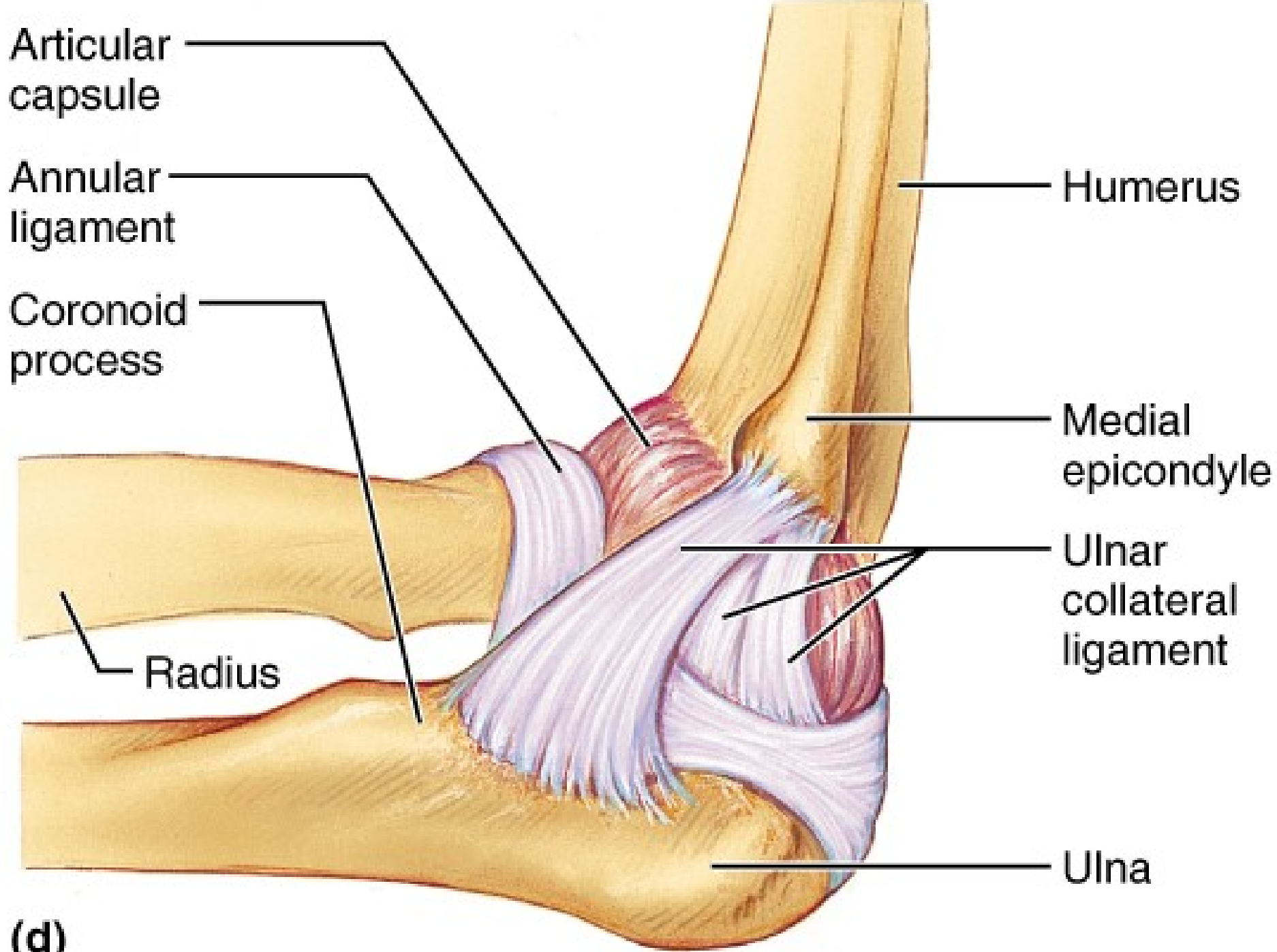
**G** Pivot joint

# Posterior View, Distal End



# **Right elbow @ 90° flexion & 90° supination, medical view**





(d)

Humerus

Lateral  
epicondyle

Articular  
capsule

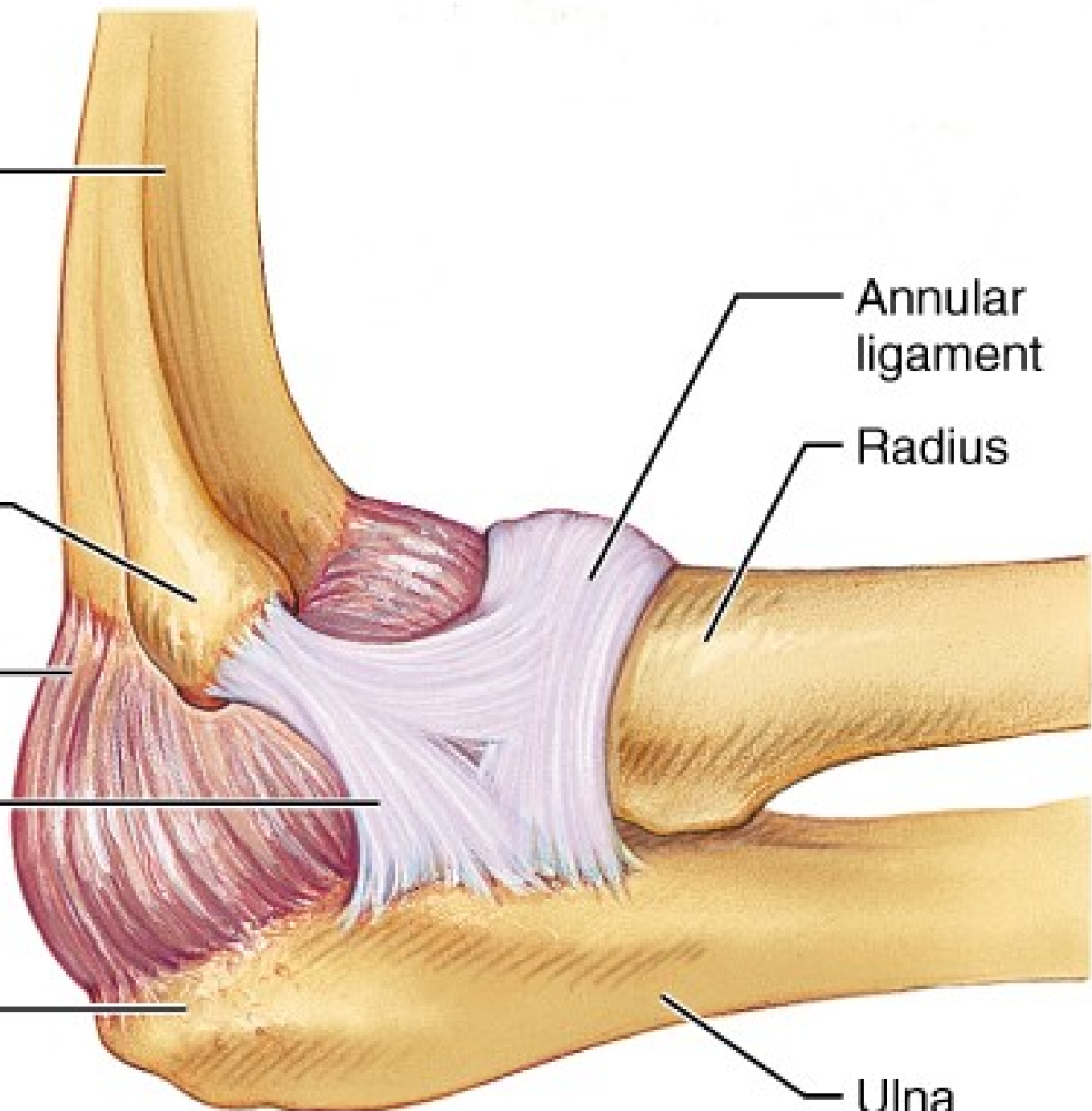
Radial  
collateral  
ligament

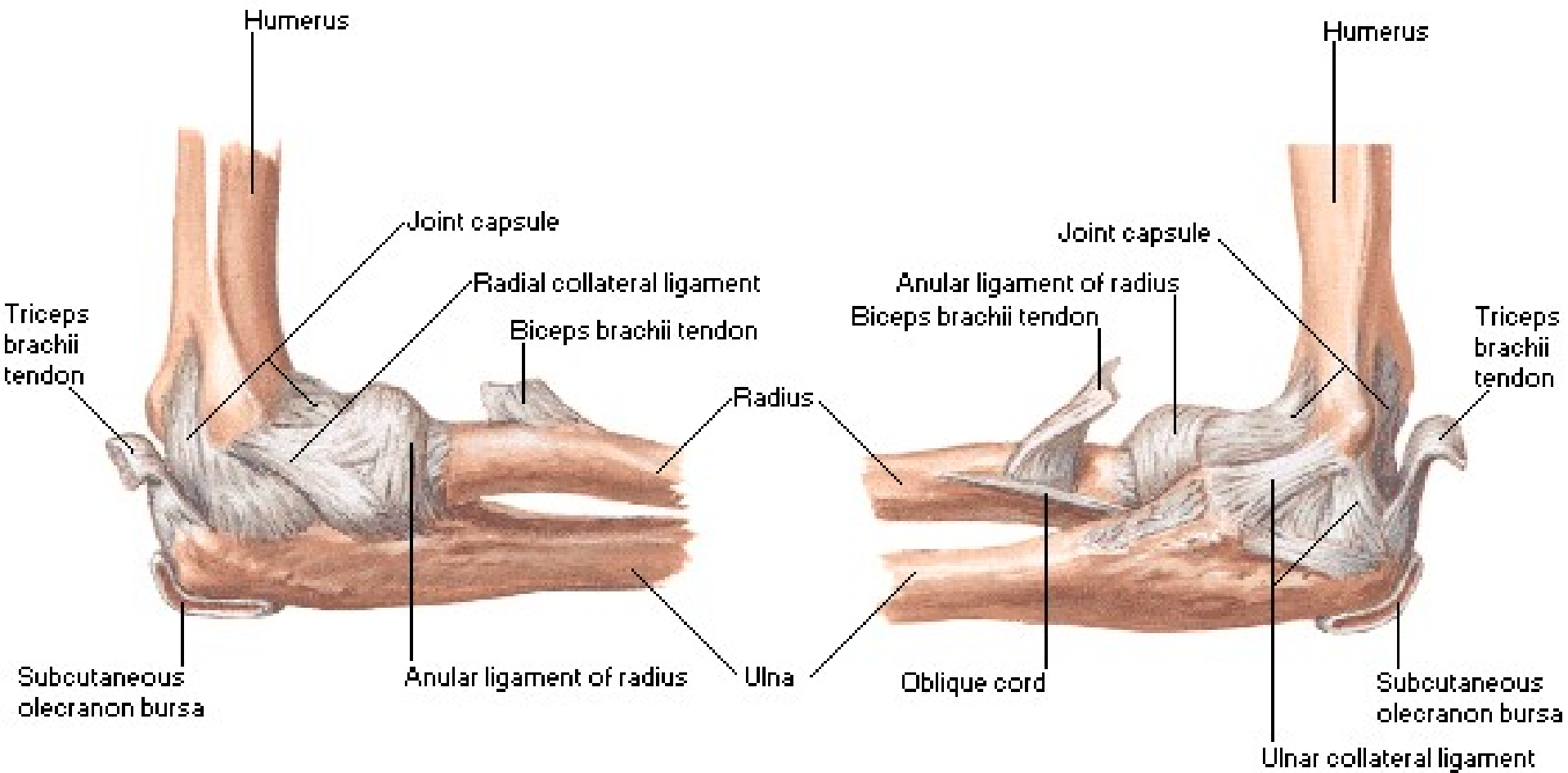
Olecranon  
process

Annular  
ligament

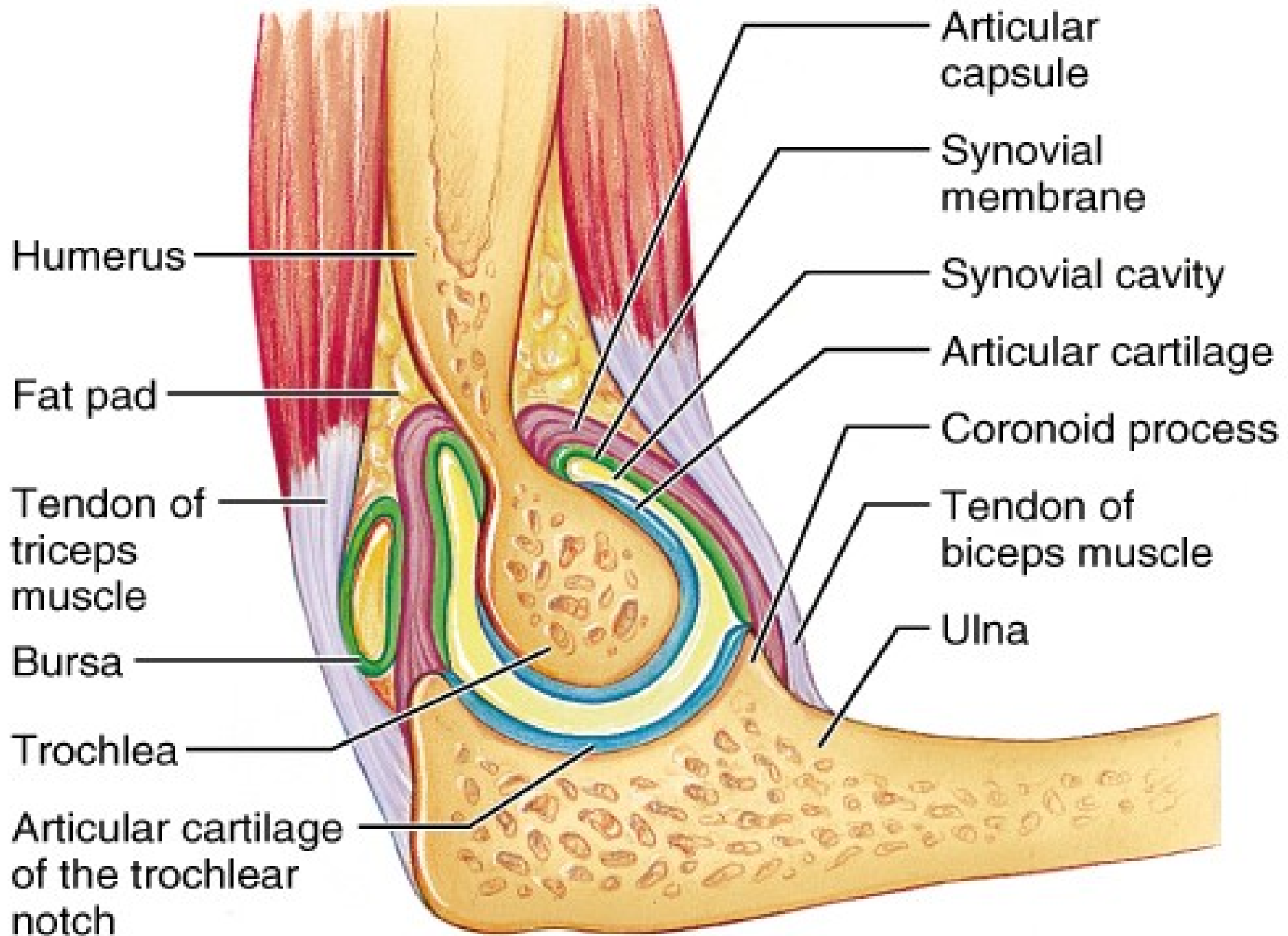
Radius

Ulna





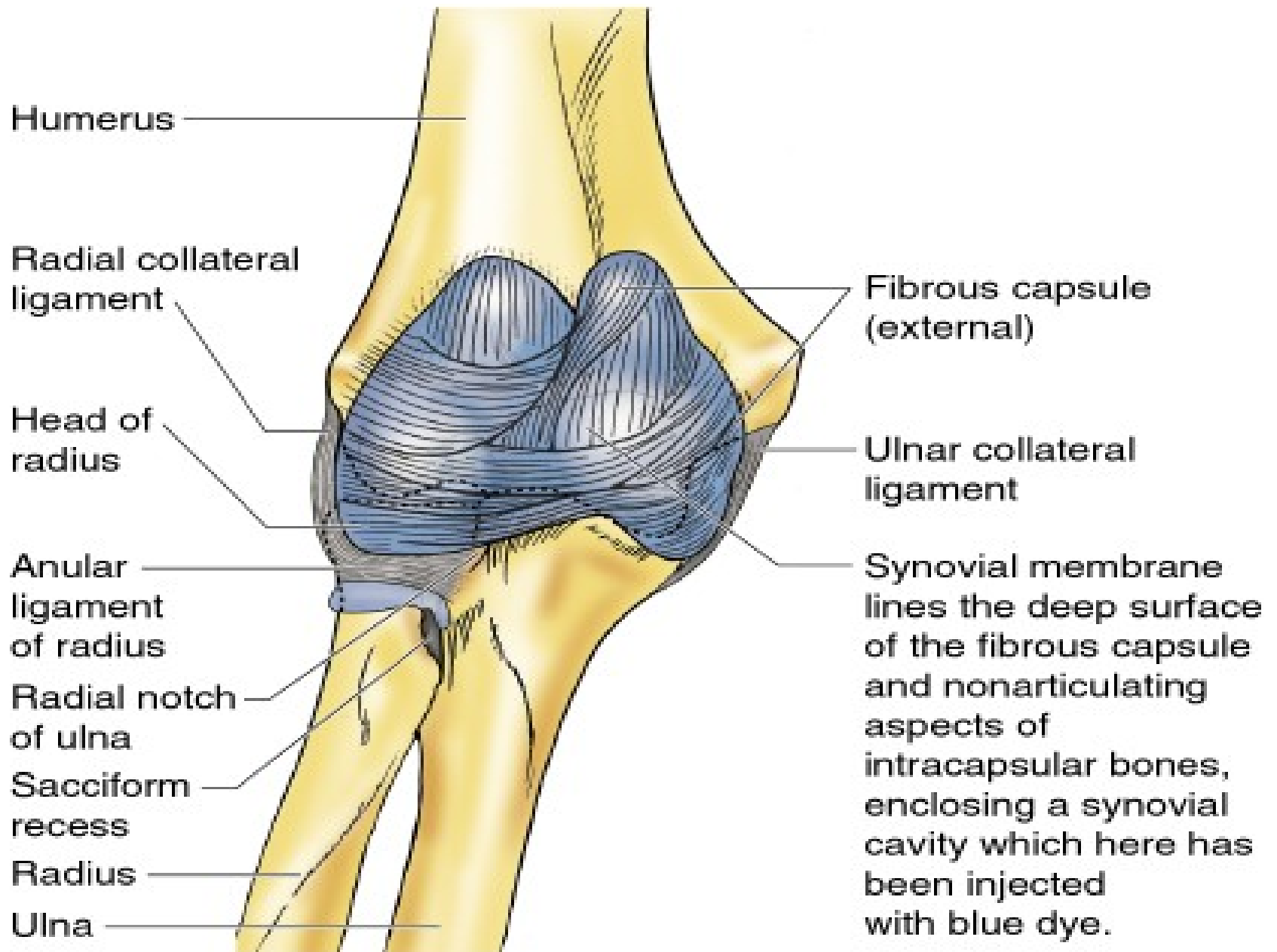


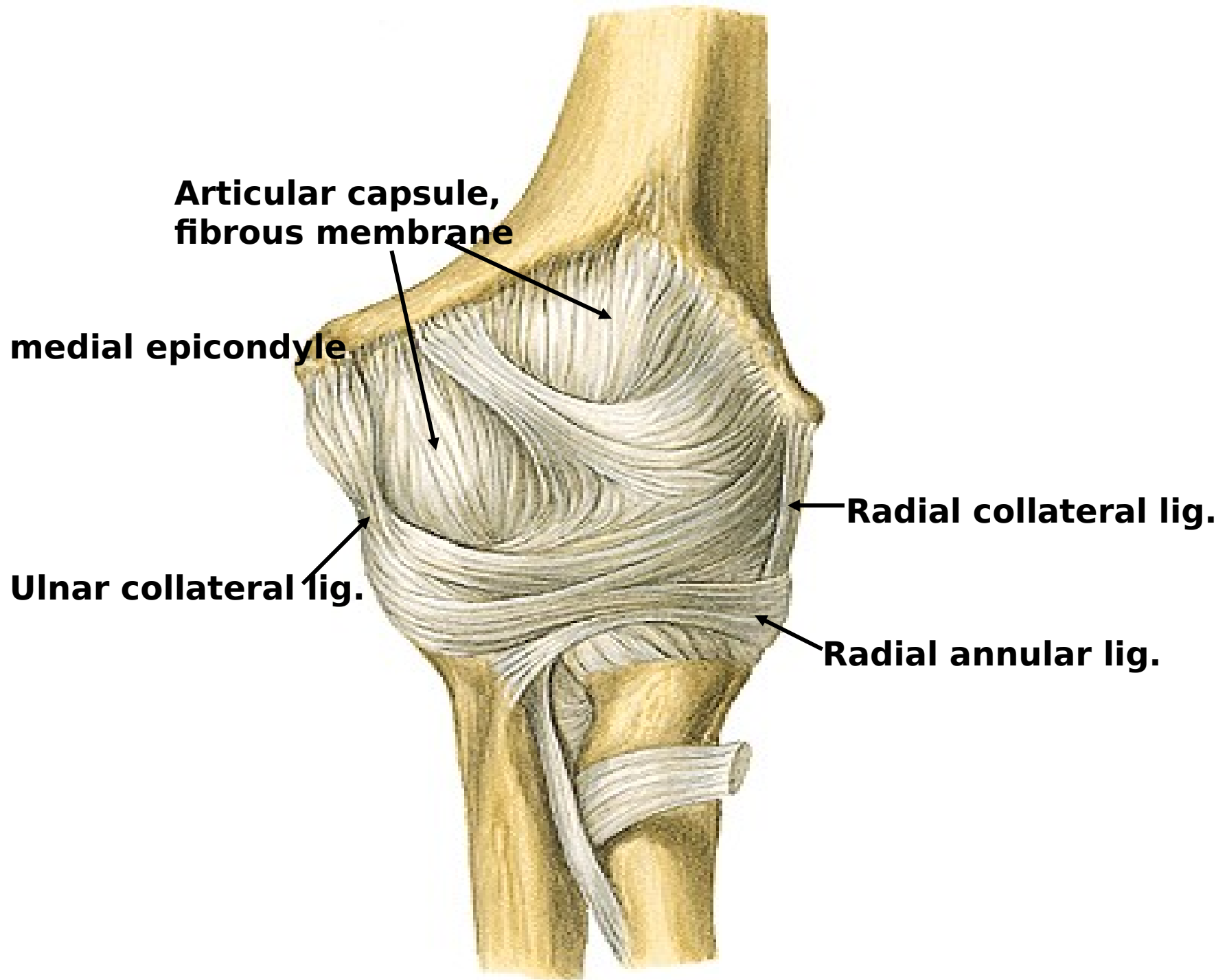


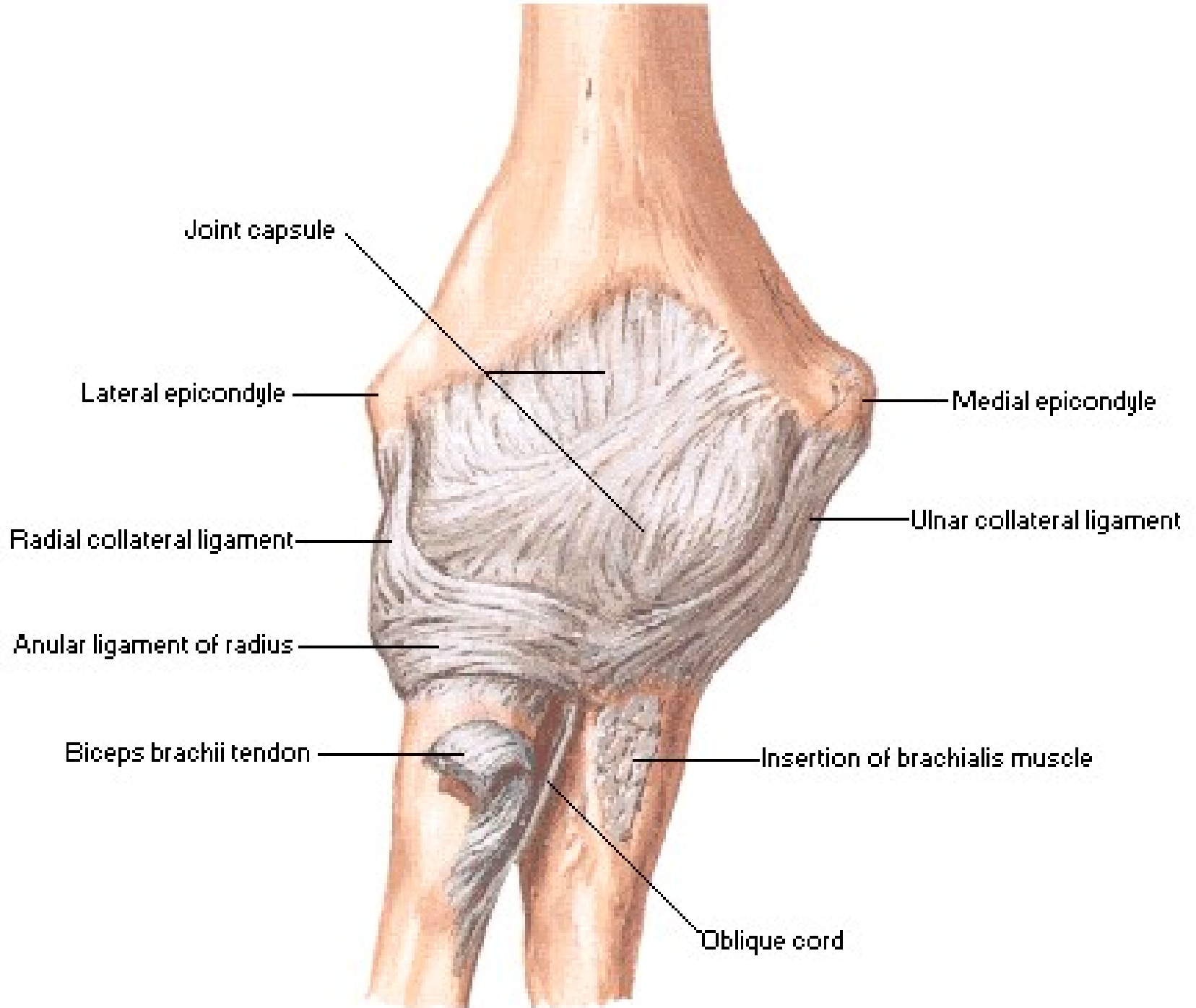
# Lateral Radiograph



6.71. Proximal radioulnar joint.







**POSTERIOR  
ASPECT**

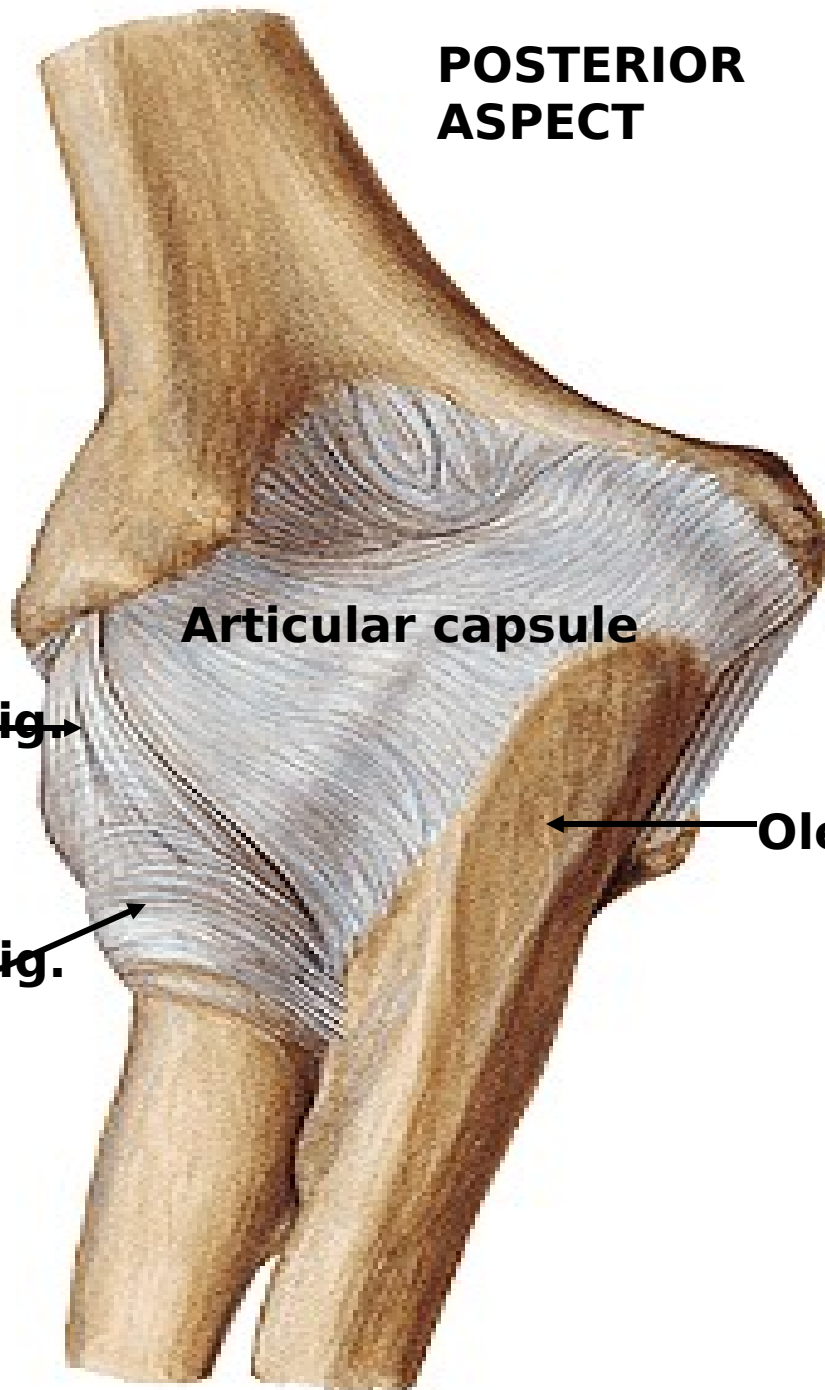
**medial epicondyle**

**Articular capsule**

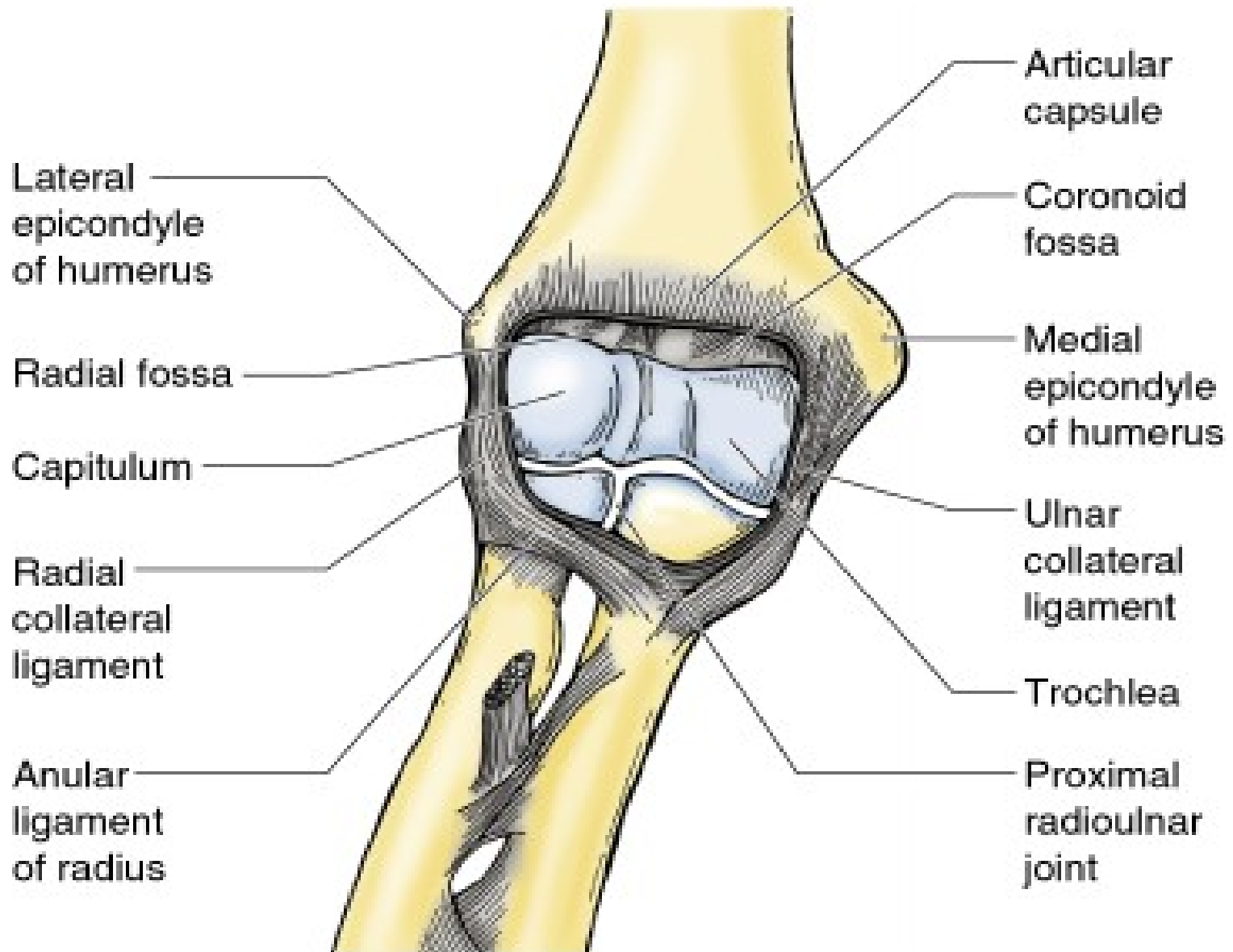
**Radial collateral lig.**

**Olecranon process**

**Radial annular lig.**



6.66A. Elbow and proximal radioulnar joints.



(A) Anterior view

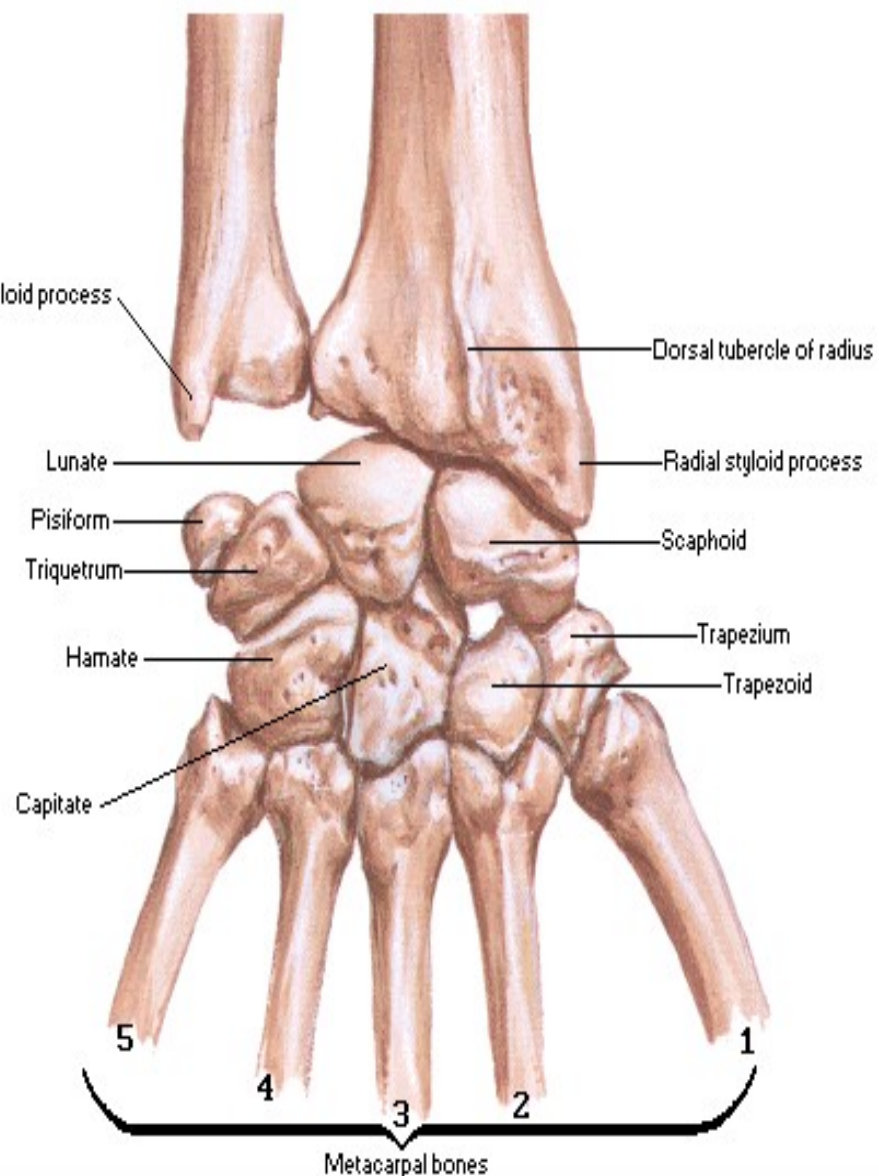
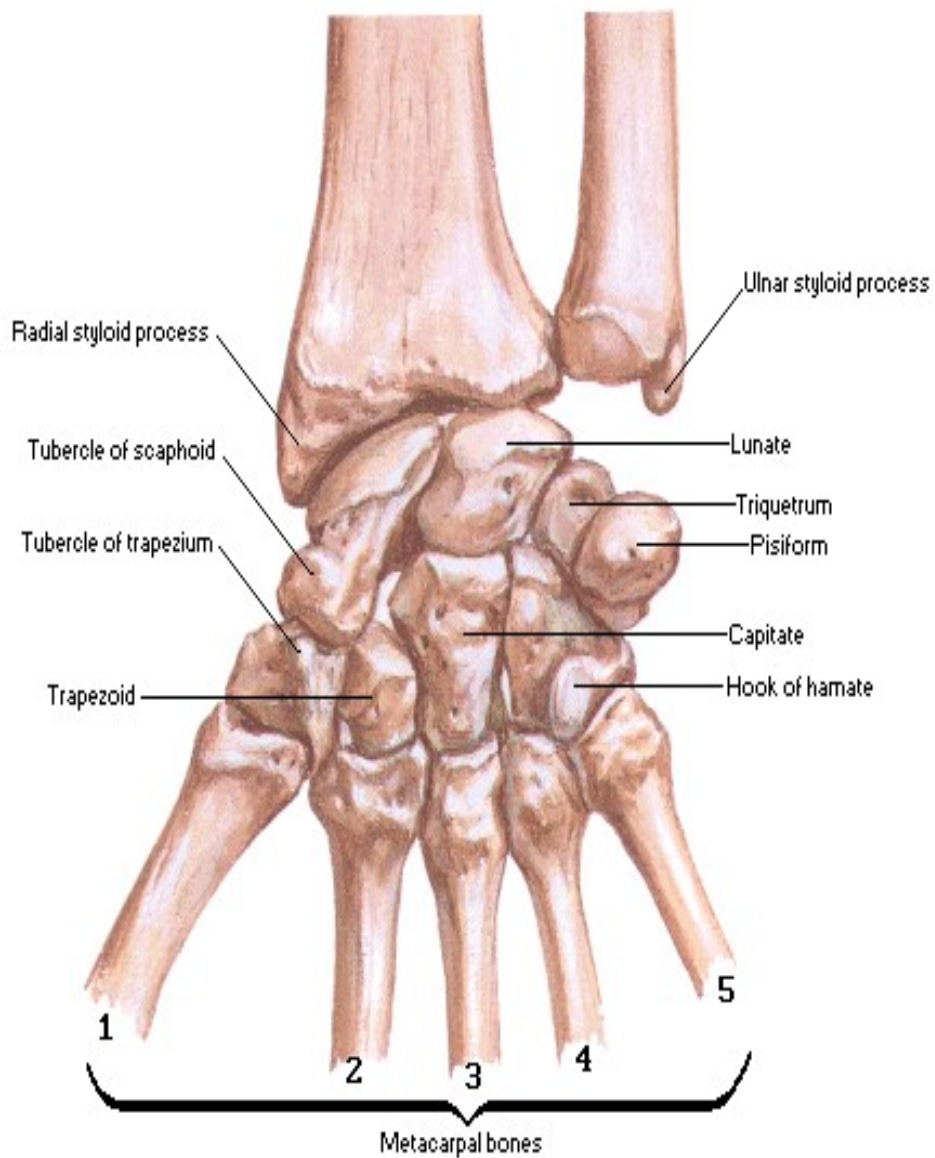
# AP Radiograph



**medial  
epicondyle**



# **JOINTS OF THE WRIST & HAND**



# Wrist - Articulations

## Joint

**Carpal joints**

a) Radiocarpal

b) Midcarpal

## Type of Joint

**Ellipsoid**

**Saddle, gliding**

## Movement

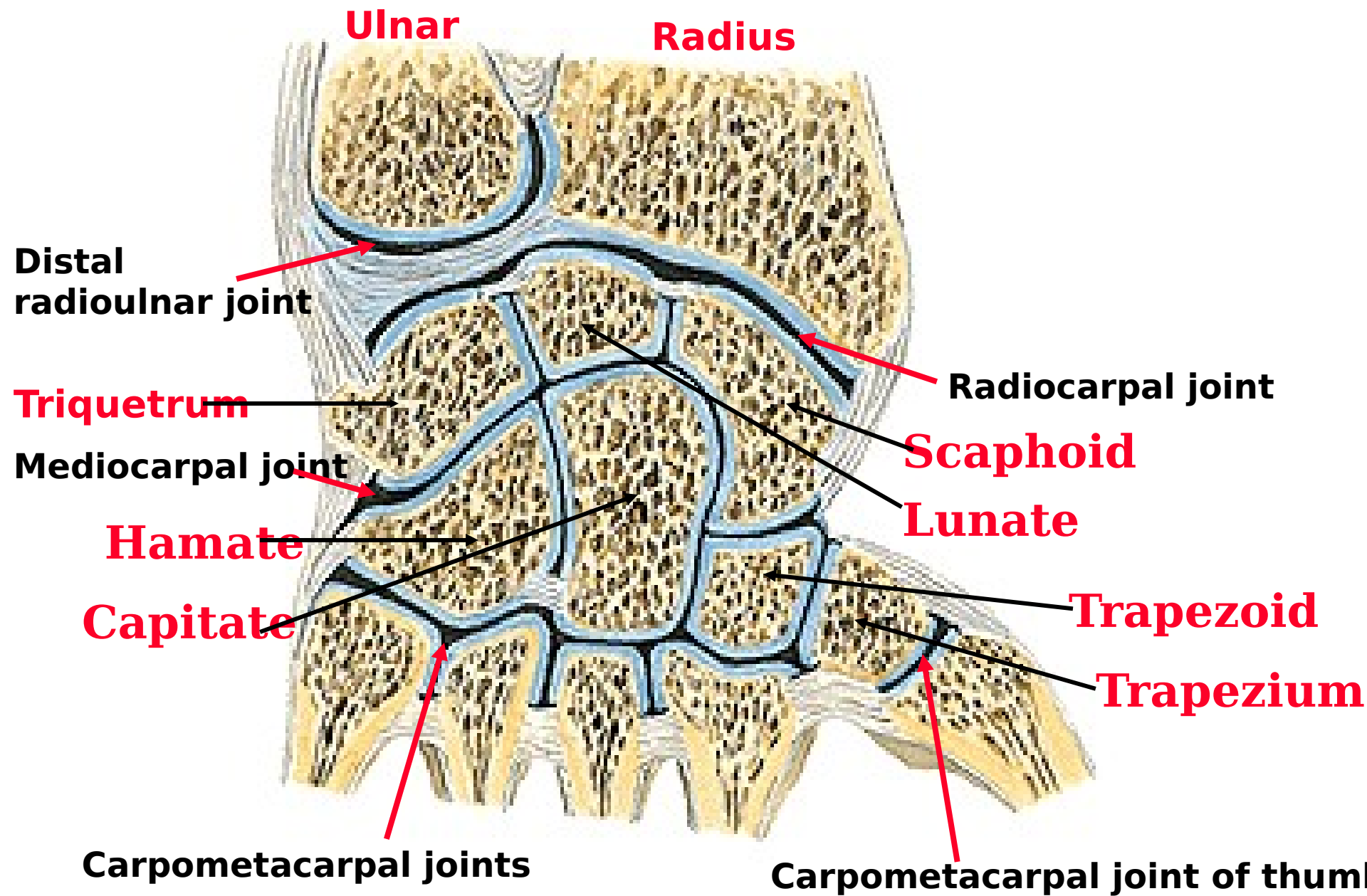
**Flexion, Extension,  
Abduction, Adduction  
Circumduction**

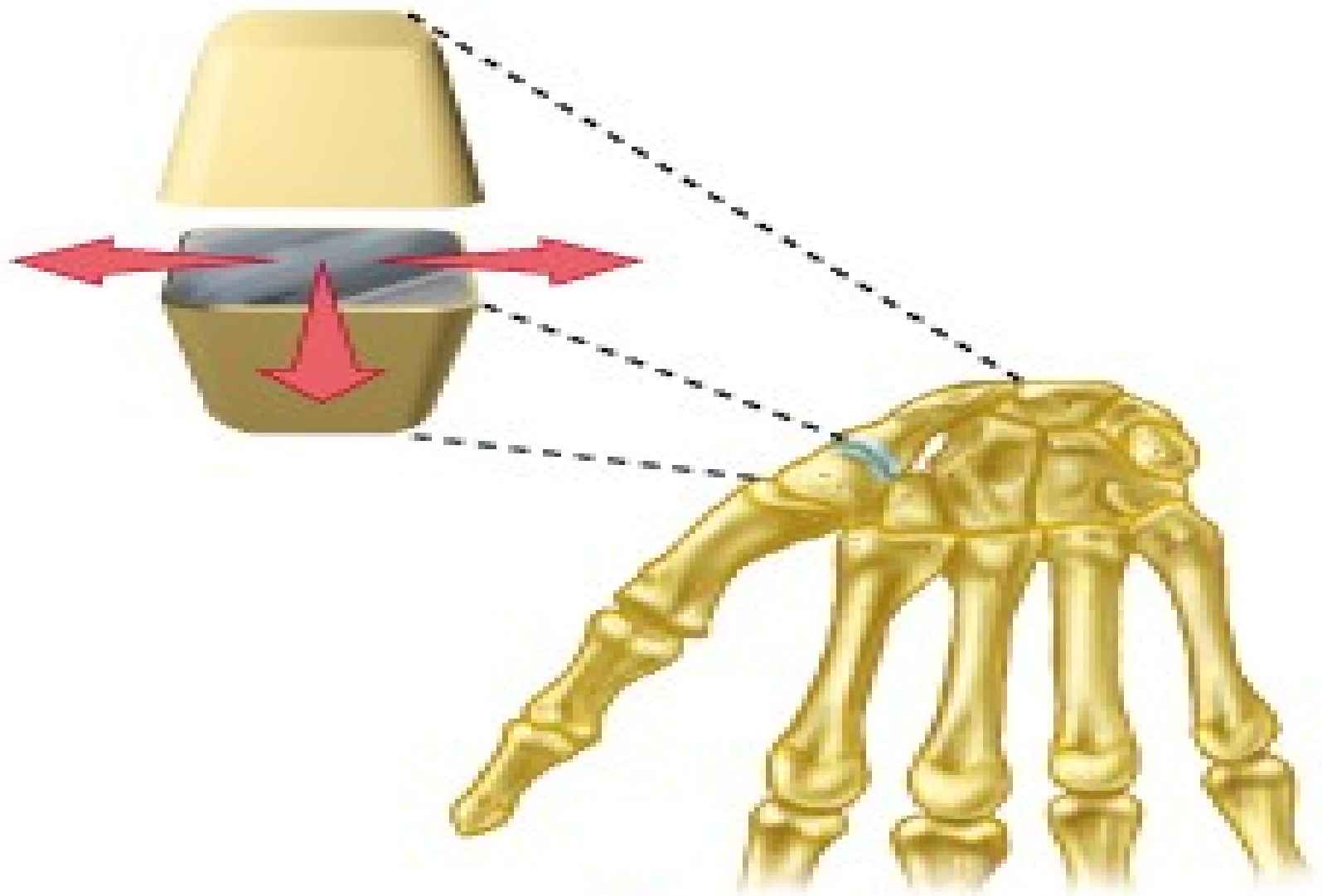
**Flexion, Extension,  
Abduction, Rotation**



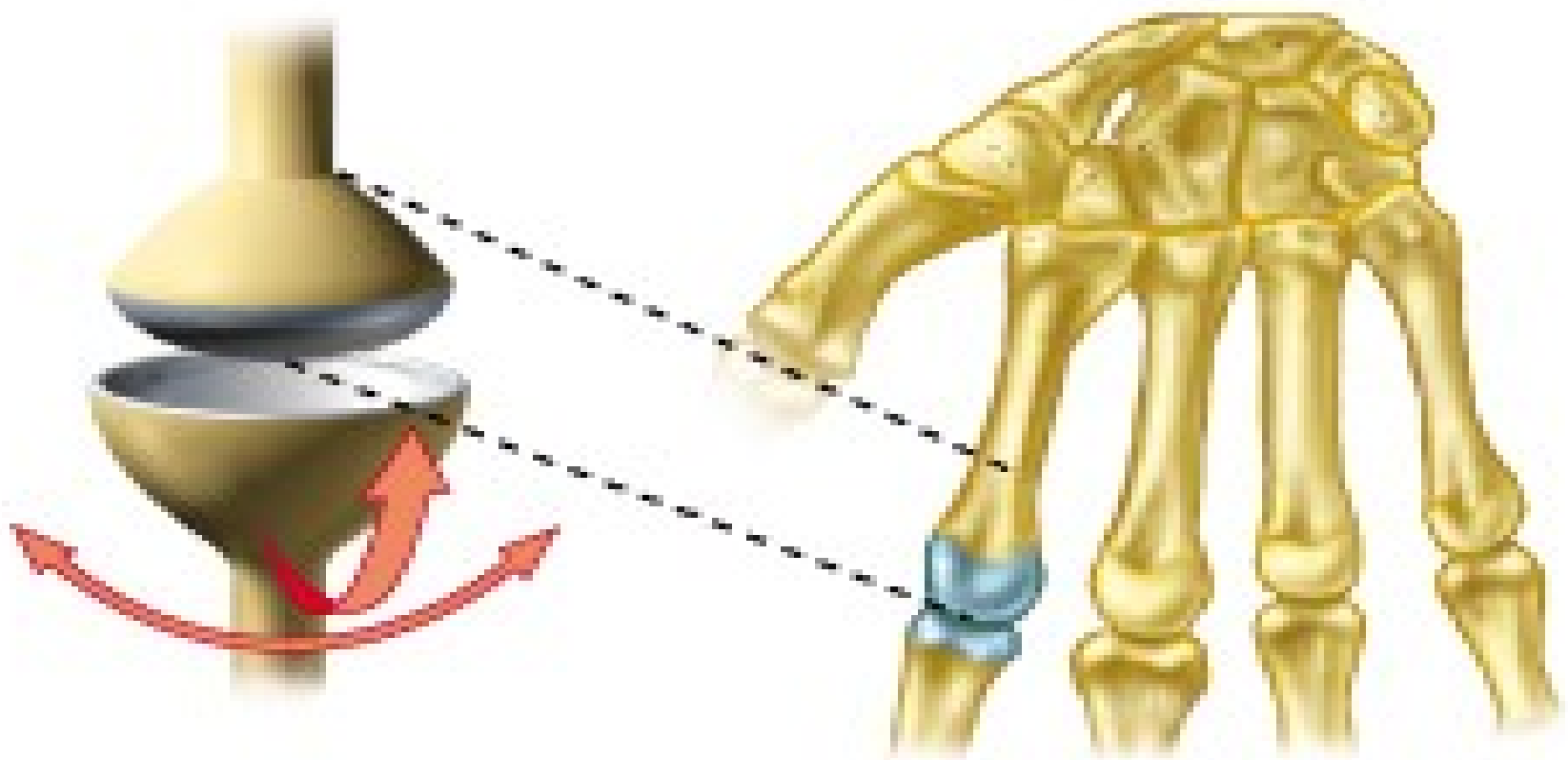
(a)

Gliding

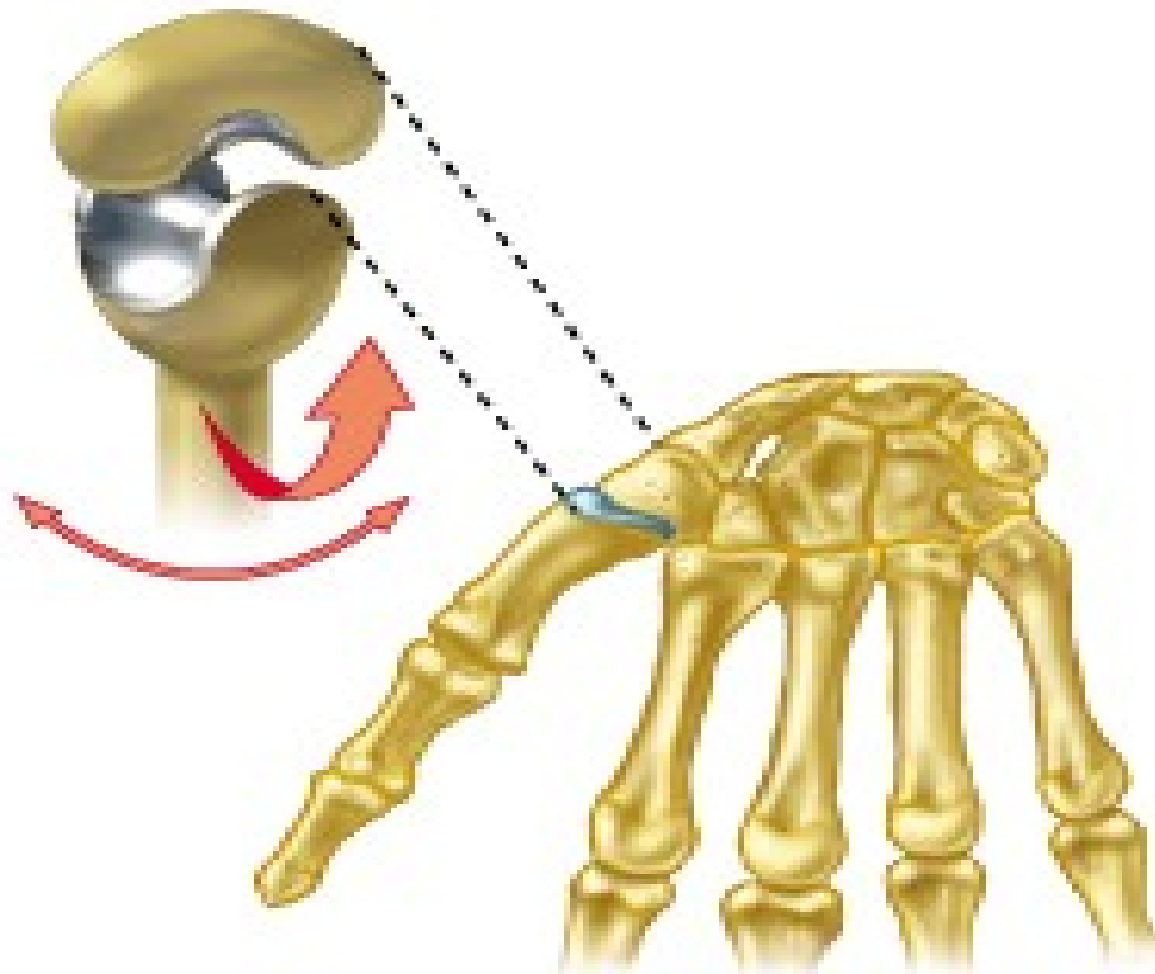




**a** Plane joint



**d** Condyloid joint



**e** Saddle joint



**CARPAL BONES**

**OSSIFICATION**





**Rt. hand -4 1/2yr old**



**Rt. hand -7yr old**



**Rt. hand -11yr old**



**Rt. hand -13yr old**

# **LIGAMENTS OF THE WRIST & HAND**

6.56. Movements of the thumb.



Abduction



Adduction



Extension



Flexion



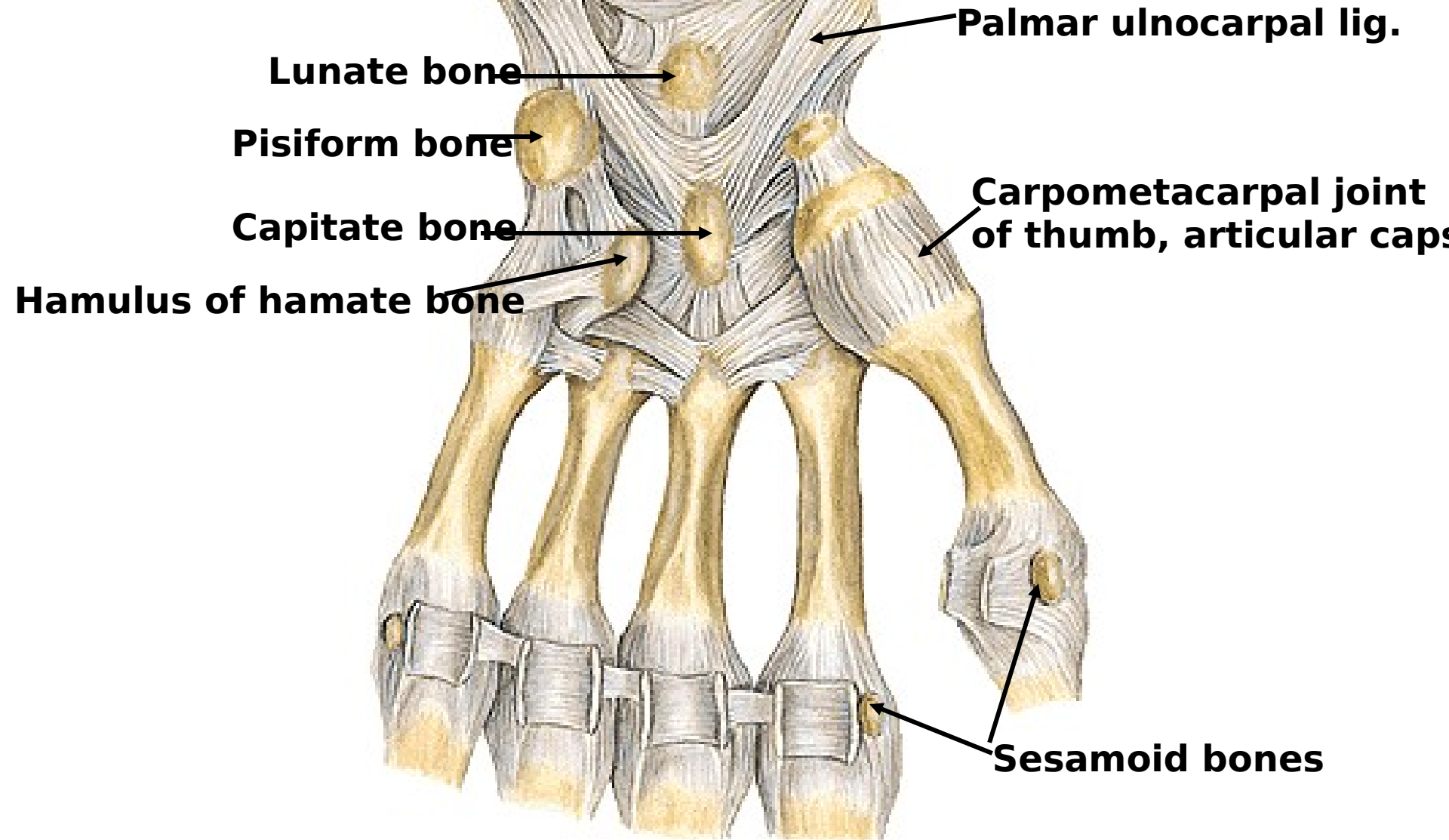
Opposition



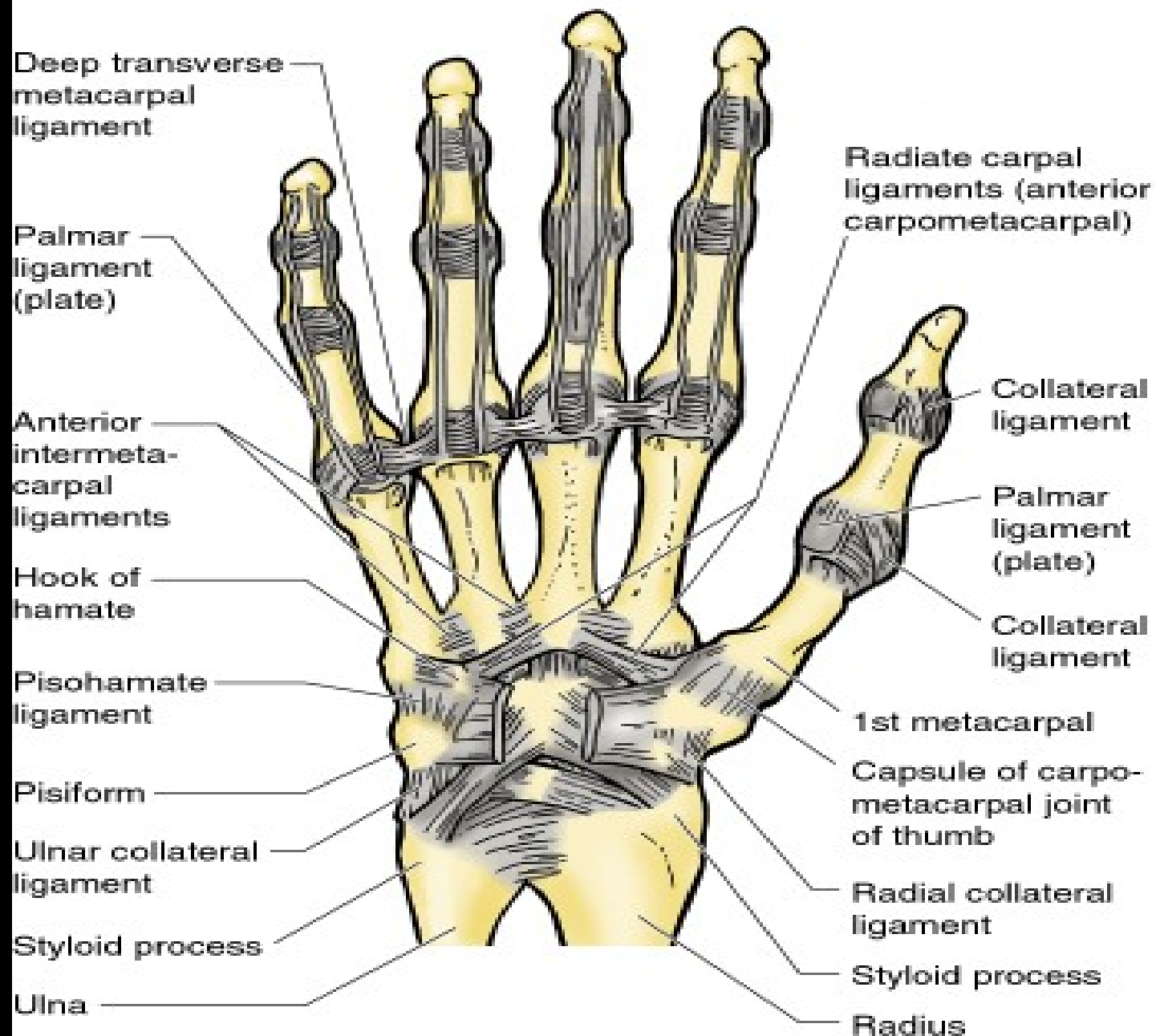
Reposition



# Joints & Ligaments of the Hand



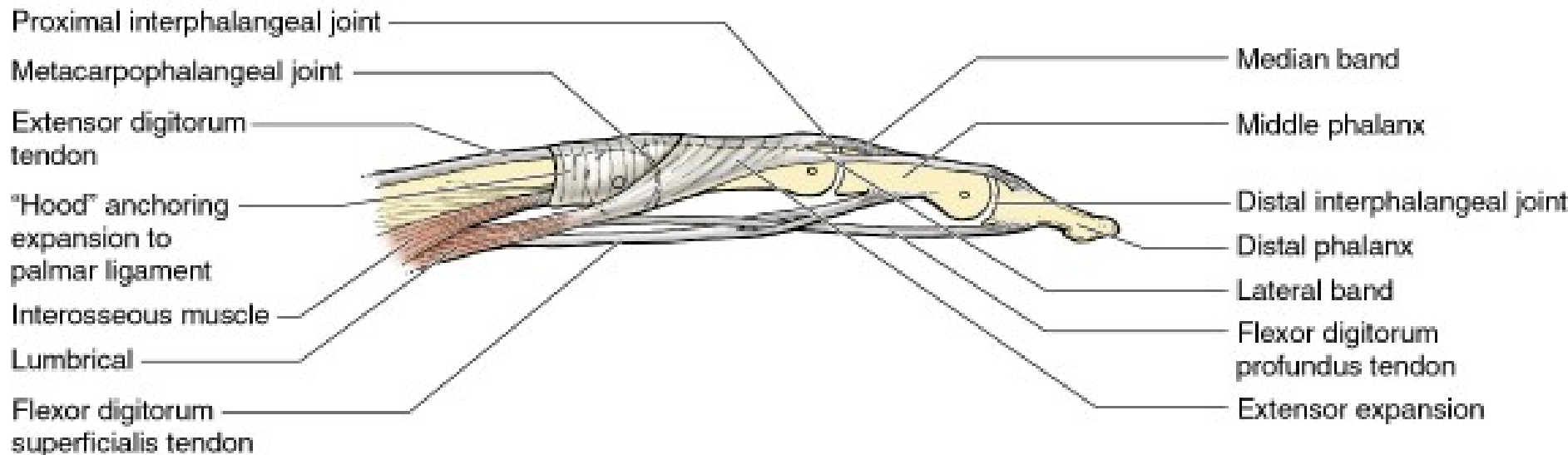
6.77A, C. Joints of the carpus and digits.



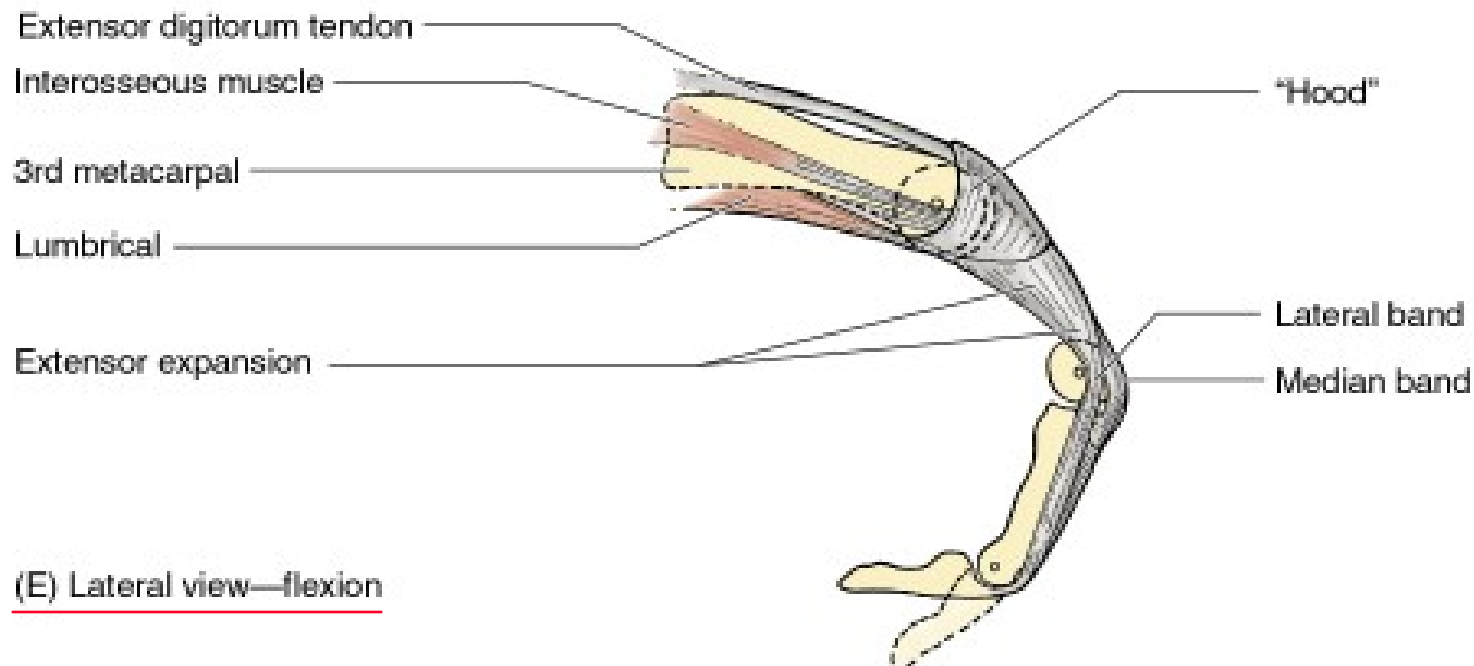
(A) Anterior view, right hand



## 6.44D-E. Extension and flexion of the 3rd digit.

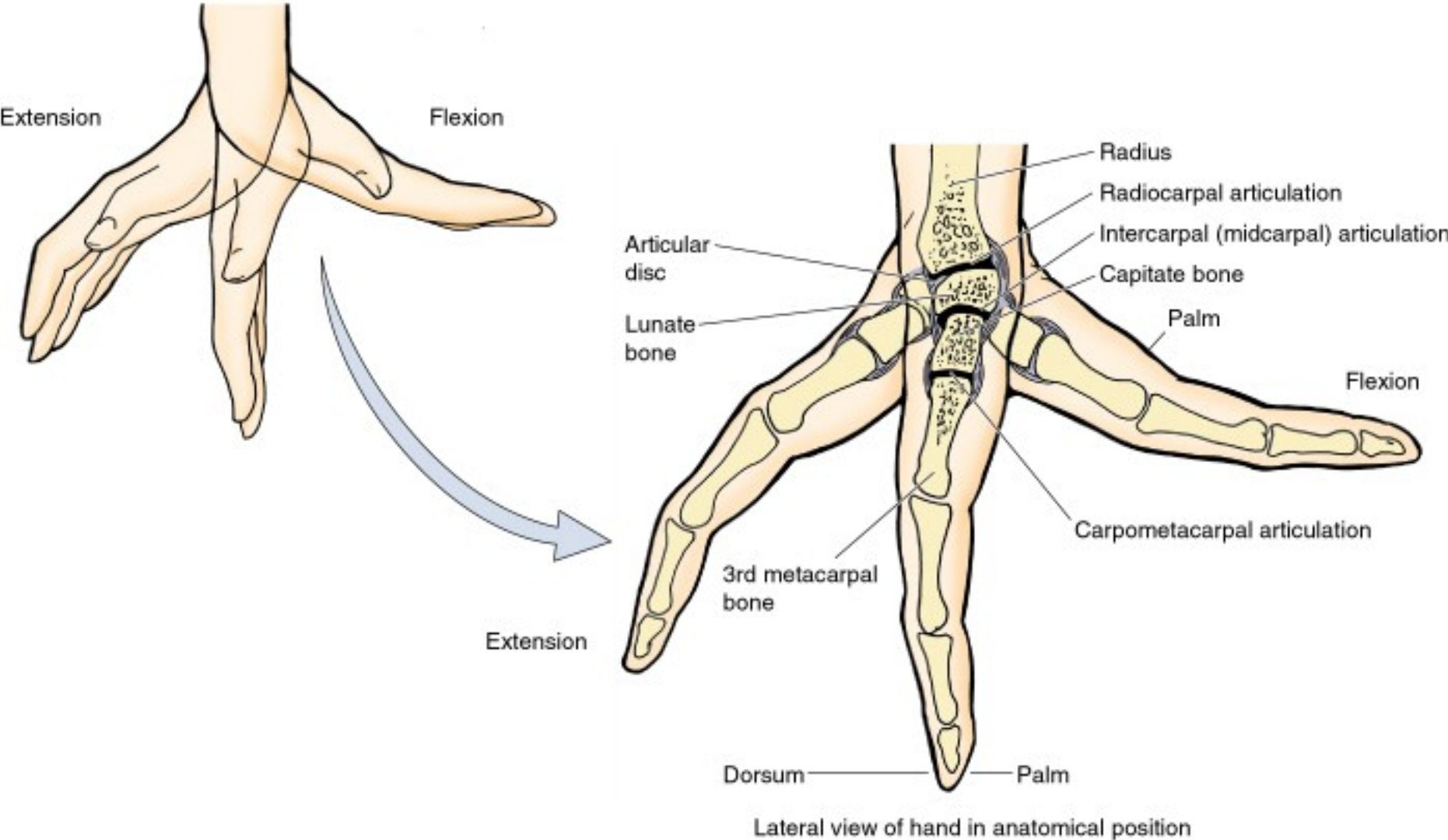


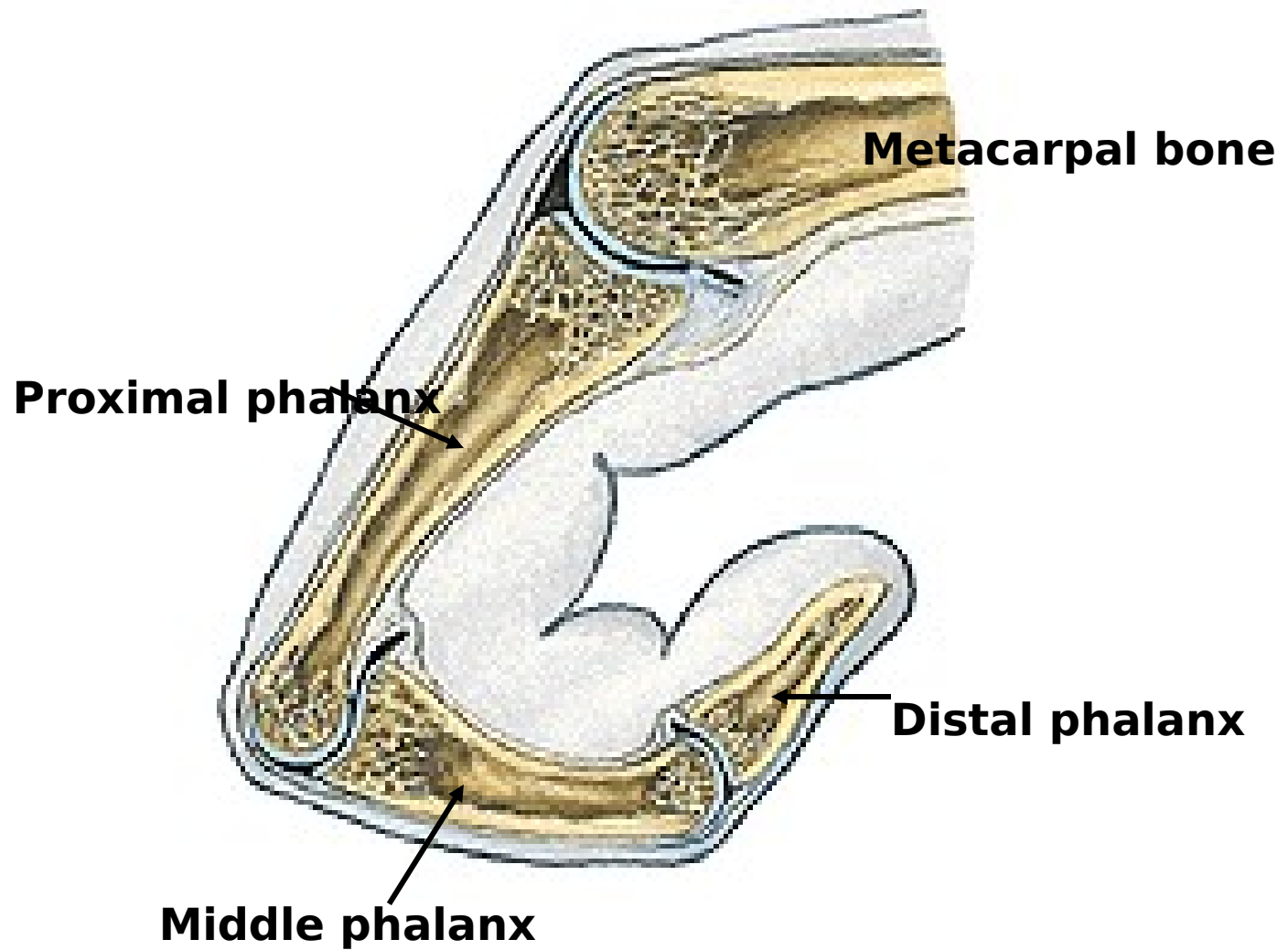
### (D) Lateral view—extension



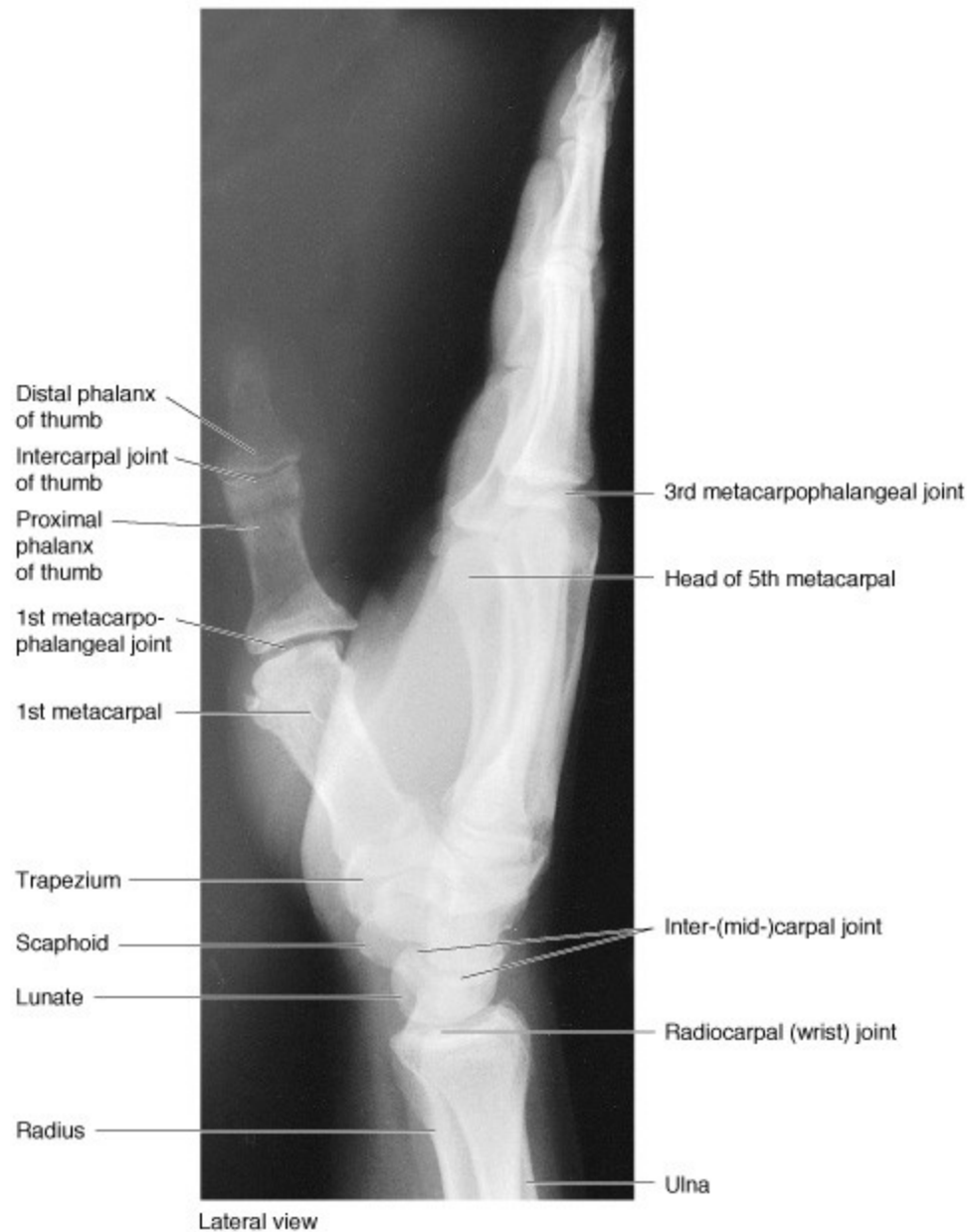
### (E) Lateral view—flexion

6.76. Sagittal section of the wrist and hand during extension and flexion.





6.81. Radiograph of an adult hand, lateral view.





# Newsweek

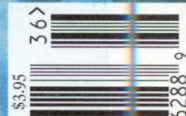
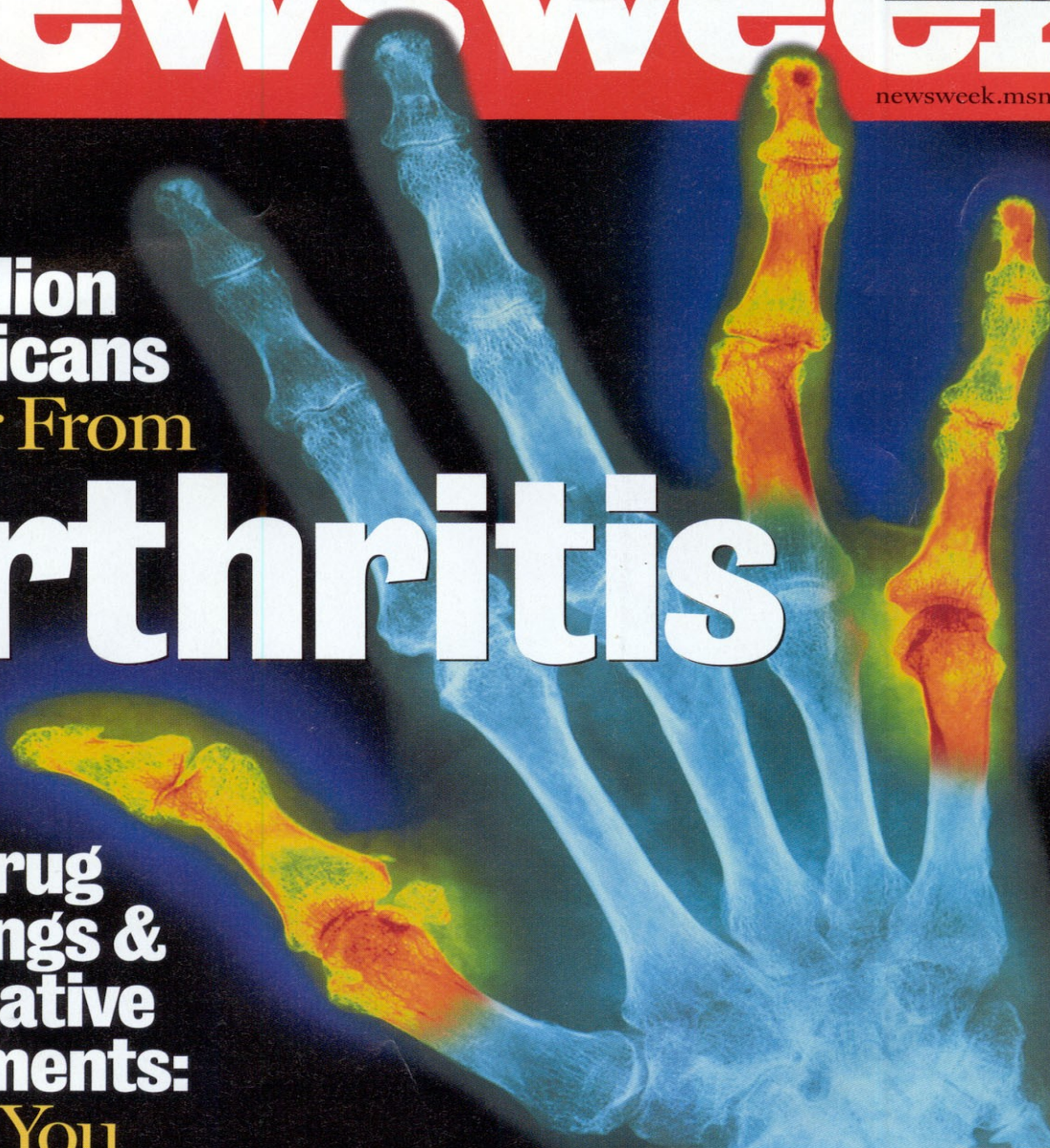
September 3, 2001

newsweek.msnbc.com

**21 Million  
Americans  
Suffer From**

# Arthritis

**New Drug  
Warnings &  
Alternative  
Treatments:  
What You  
Should Know**





# Knuckle Cracking

- Knuckle cracking does not cause arthritis, enlarged joints, or any other harm.
- The popping sound results when the two opposing bones in the knuckles are pulled apart, which creates a vacuum within the joint.
- A small amount of gas dissolved in the joint fluid is quickly released forming a bubble that almost instantly collapses and produces the noise.

# QUESTIONS?



# **THE SHOULDER**

Anatomy & Physiology I

# General Considerations

- The **musculoskeletal exam** is all about **anatomy**.
- Think of the underlying anatomy as you obtain the history and examine the patient.

# **General Considerations**

- When taking a history for an acute problem always inquire about the mechanism of injury, loss of function, onset of swelling (< 24 hours), and initial treatment.

# General

## Considerations

- When taking a history for a chronic problem always inquire about past injuries, past treatments, effect on function, and current symptoms.
- The cardinal signs of musculoskeletal disease are pain, redness (erythema), swelling, increased warmth,

# **General Considerations**

- Always begin with inspection, palpation and range of motion, regardless of the region you are examining.

# Regional Considerations

- Remember that the **clavicle** is part of the shoulder. Be sure to include it in your examination.
- The **patella** is much easier to examine if the leg is extended and relaxed.
- Be sure to palpate over the **spinous process** of each



# Regional Considerations

- It is always helpful to **observe** the patient **standing** and **walking**.
- Always consider **referred pain**, from the neck or chest to the shoulder, from the back or pelvis to the hip, and from the hip to the knee.
- Pain with, or limitation of,

# Considerations

## Inspection

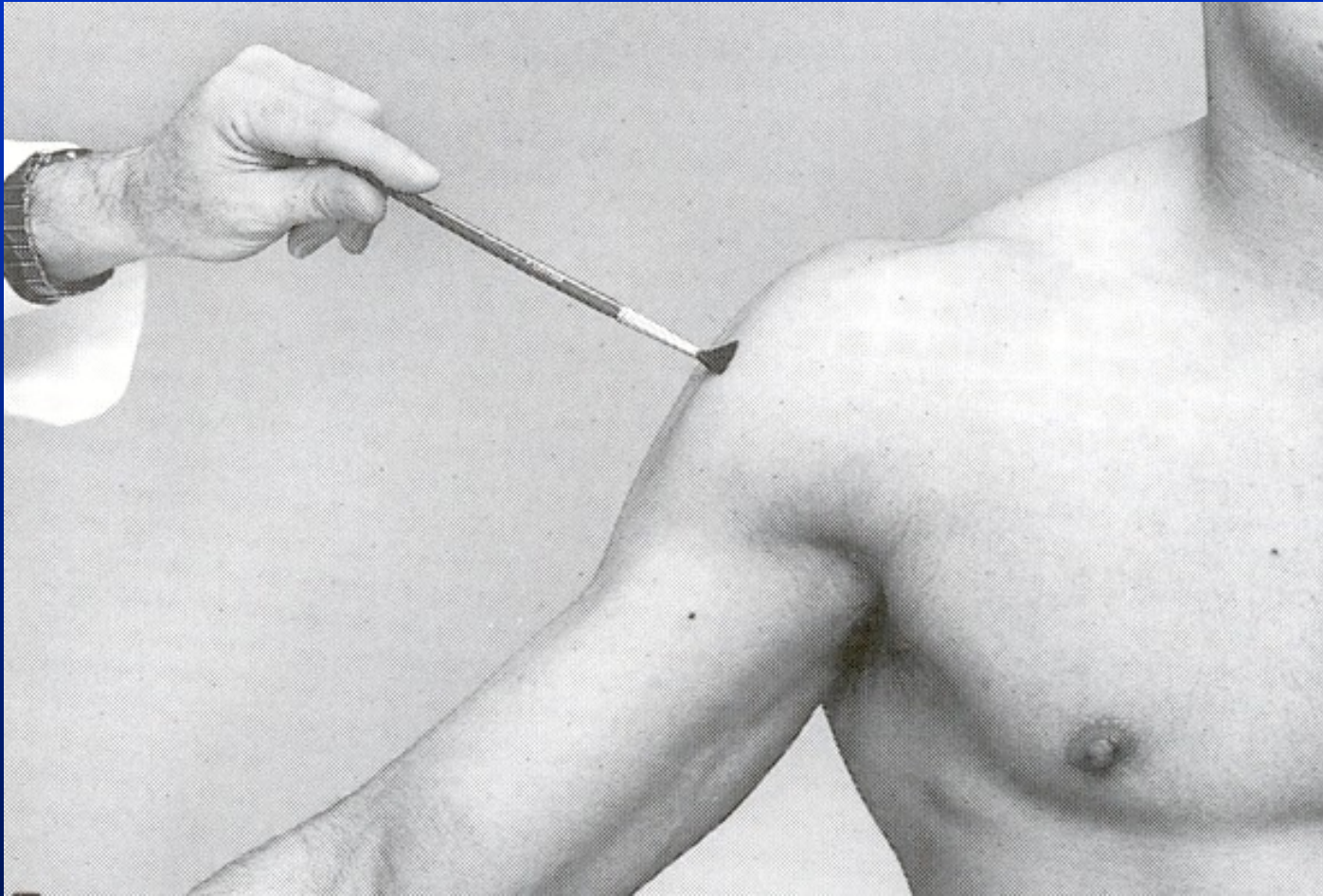
1. Look for scars, rashes, or other lesions.
2. Look for asymmetry, deformity, or atrophy.
3. Always compare with the other side.

# Considerations

## Palpation

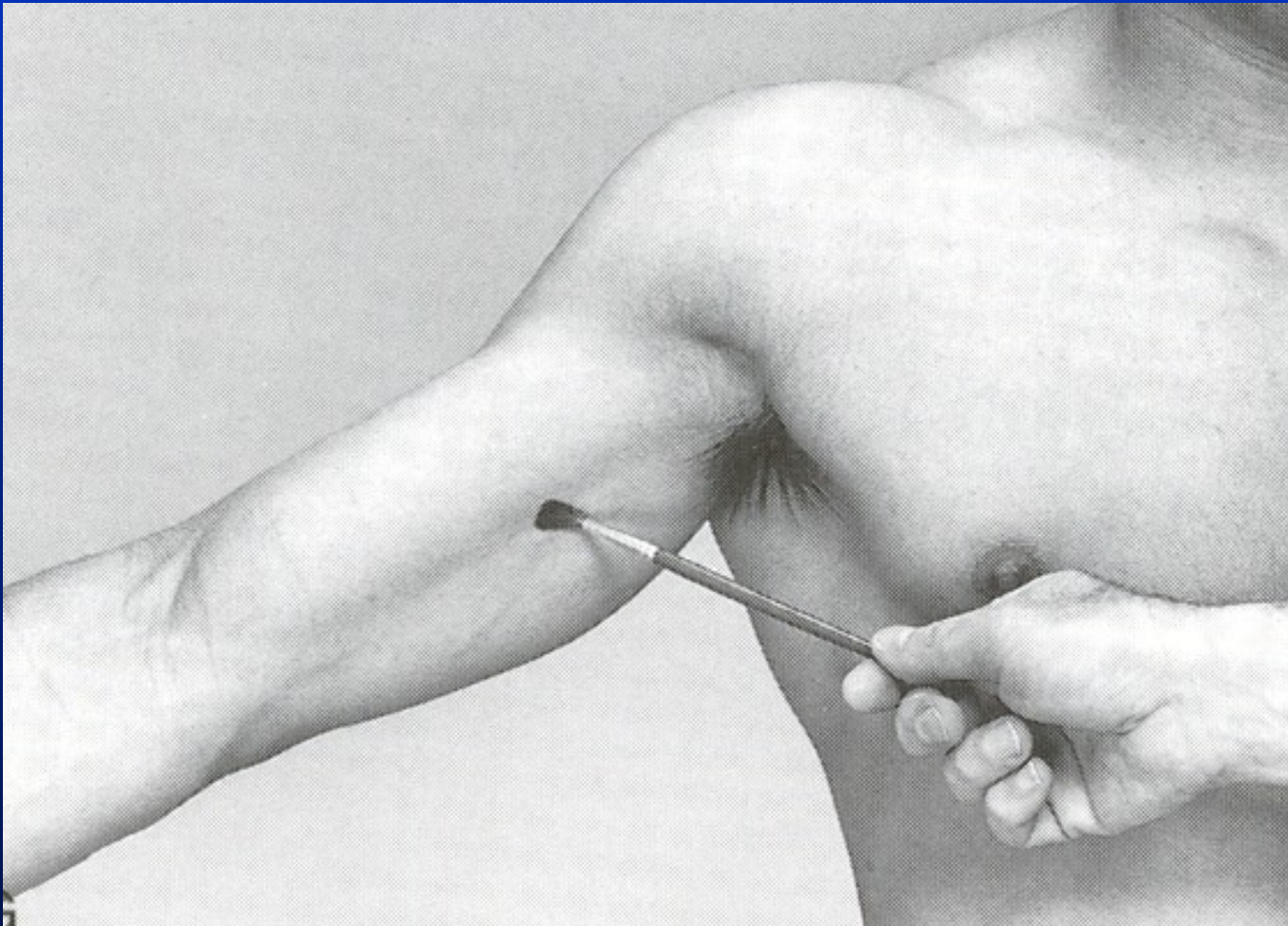
1. Examine each major joint and muscle group in turn.
2. Identify any areas of tenderness.
3. Identify any areas of deformity.
4. Always compare with the

# **SENSORY**



**C5**

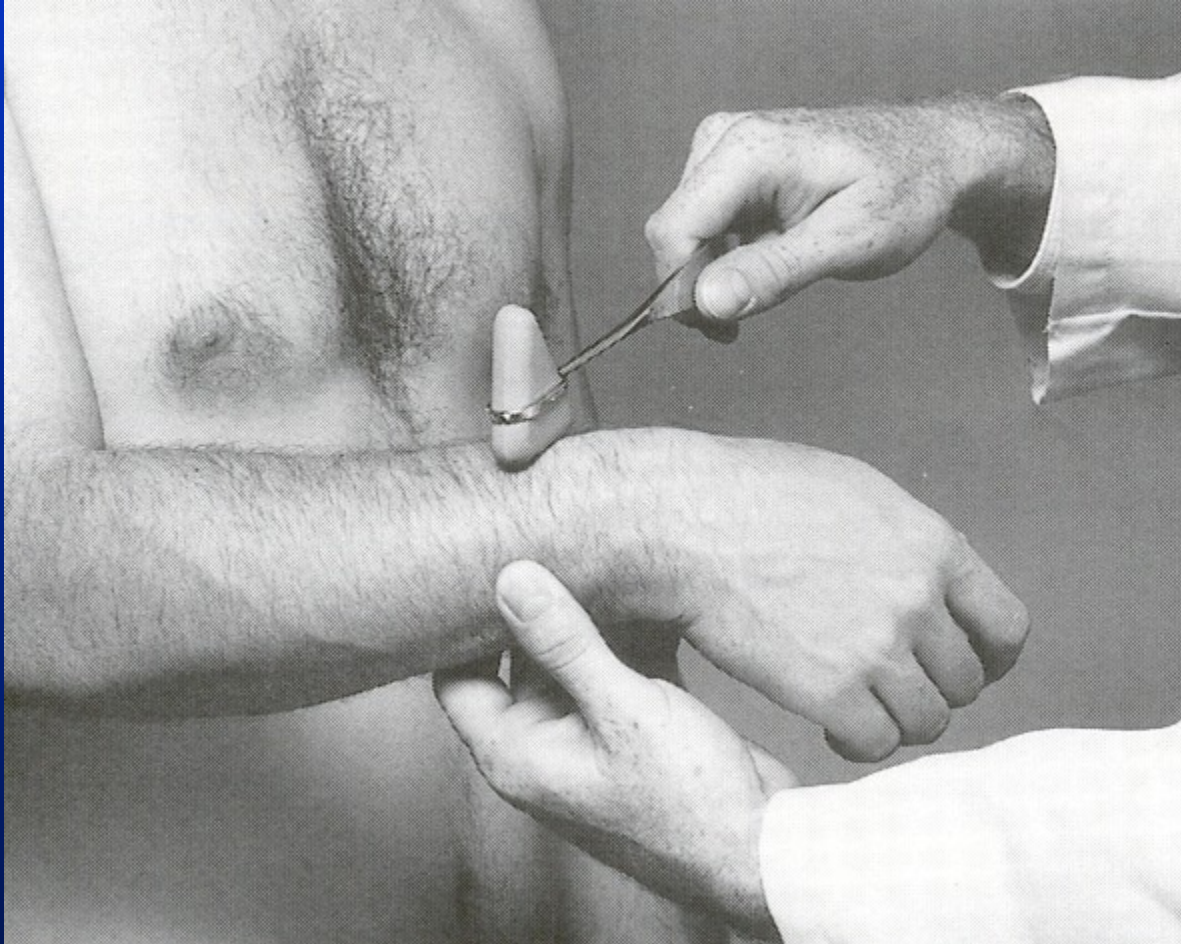
# ***SENSORY***



**T2**

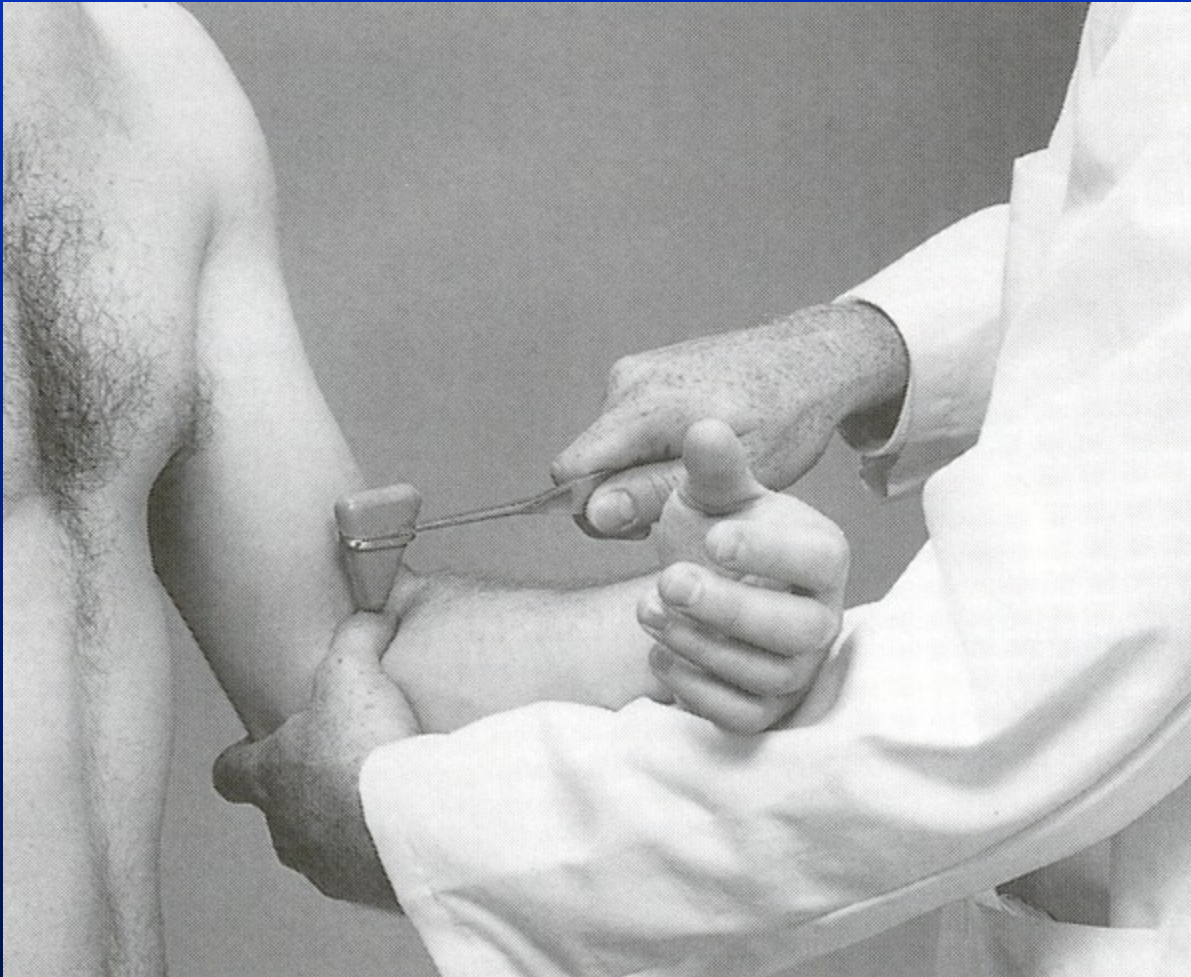


# **REFLEXES**



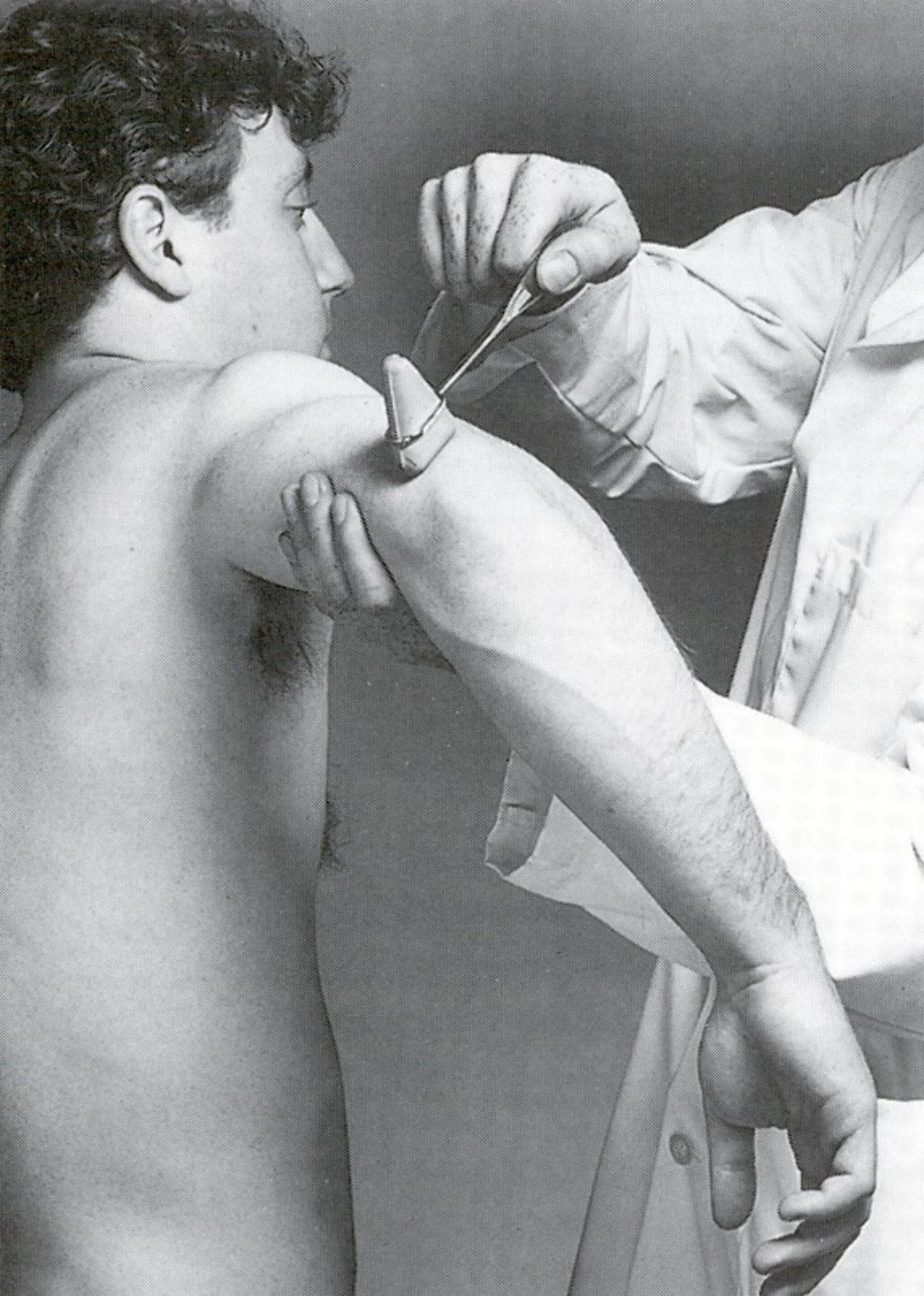
**BRACHIO-  
RADIALIS  
(C6)**

# **REFLEXES**



**BICEPS  
(C5)**





**REFLEXE**

**S**

**TRICEPS  
(C7)**



# Considerations

## Range of Motion

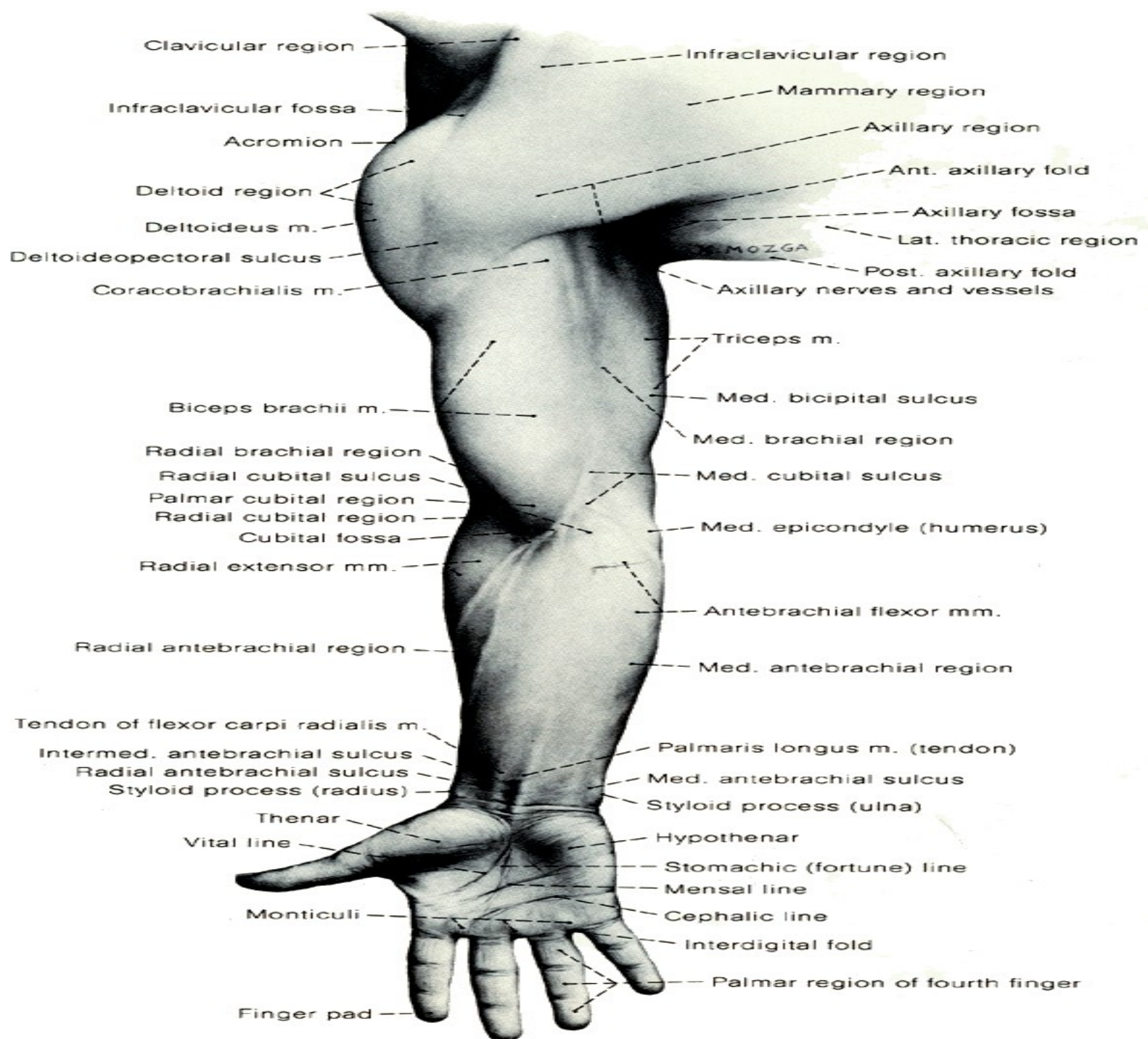
- Start by asking the patient to move through an active range of motion (**joints** moved by **patient**).
- Proceed to passive range of motion (**joints** moved by **examiner**) if active range of motion is abnormal.

# Regional Considerations

- Diagnostic hints based on location of pain:

	Back	Side	Front
Shoulder Pain	Muscle Spasm	Bursitis or Rotator Cuff	Glenohumeral Joint
Hip Pain	Sciatic a	Bursitis	Hip Joint

# **SURFACE ANATOMY**

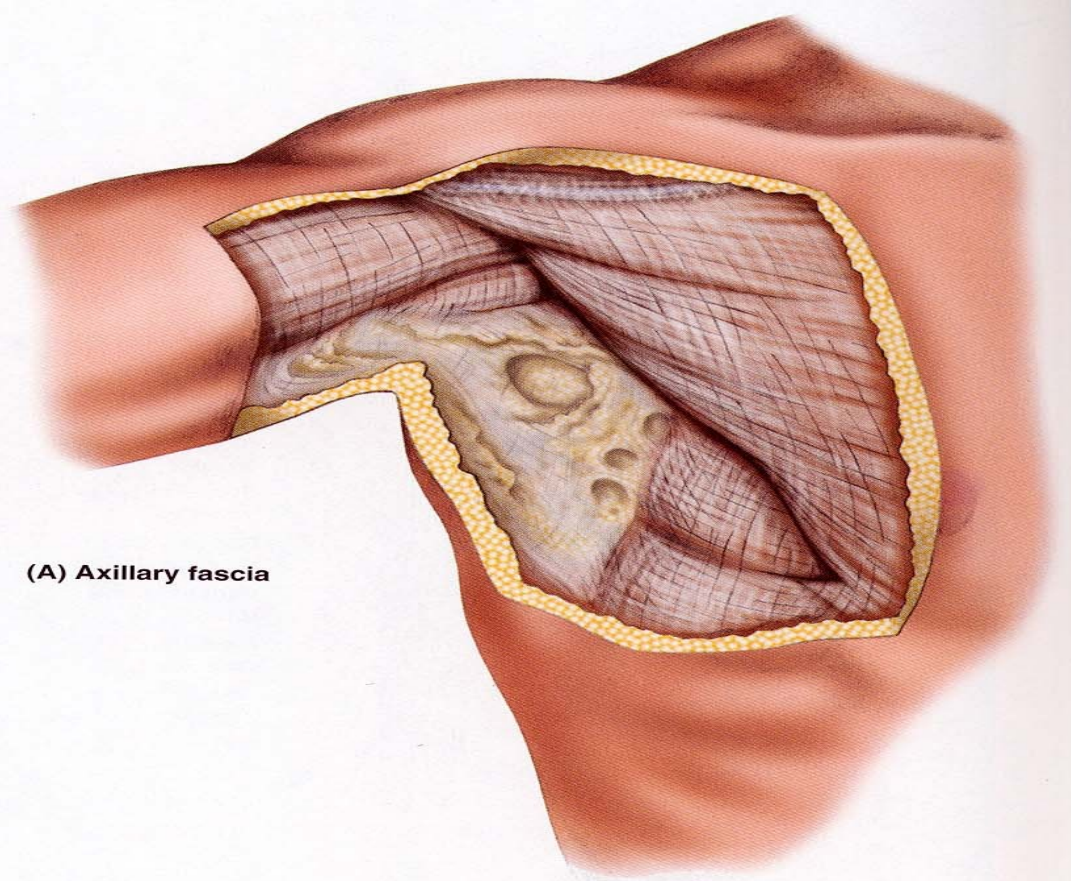
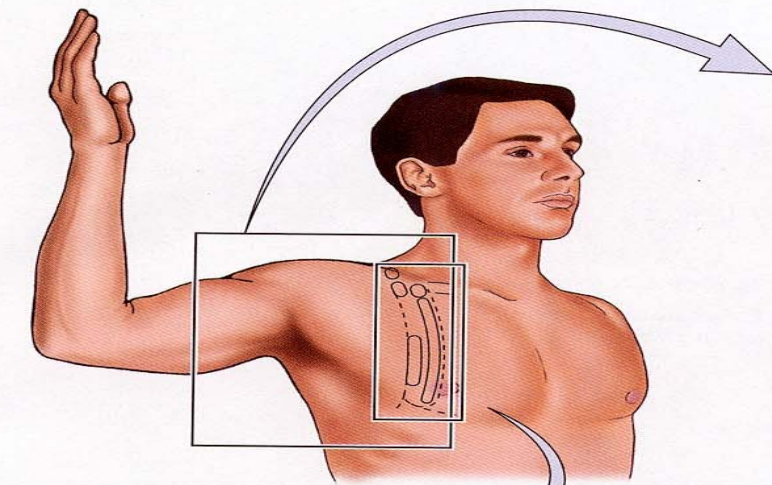




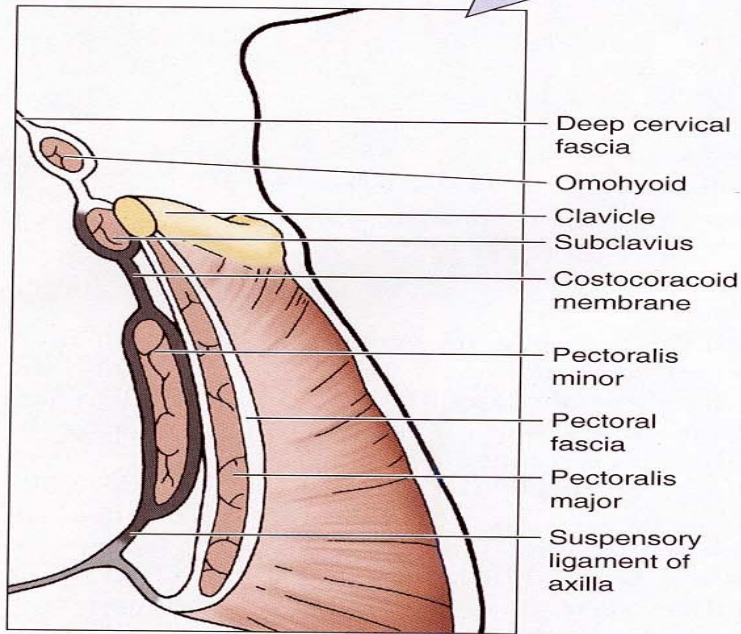


**Figure 6.10. Fascia of the upper limb.** The *brachial fascia*, the deep fascia of the arm, is continuous superiorly with the pectoral and axillary layers of fascia. Medial and lateral intermuscular septa extend from the deep aspect of the brachial fascia to the humerus, dividing the arm into anterior and posterior compartments, each of which contains muscles serving similar functions, and the nerves and vessels supplying them. The *antebrachial fascia*, surrounding the forearm muscles, is continuous with the brachial fascia and the deep fascia of the hand. The *interosseous membrane* and the bones it connects (radius and ulna) separate the forearm into anterior and posterior compartments. Over the distal ends of the radius and ulna, the deep fascia of the forearm thickens to form the *extensor retinaculum* posteriorly and a corresponding (but officially unnamed) thickening anteriorly—identified by some authors as the “palmar carpal ligament.” Immediately distal and at a deeper level to the latter—but also continuous with the antebrachial fascia—a ligamentous formation—the *flexor retinaculum*—extends between anterior prominences of the outer carpal bones, converting the anterior concavity of the carpus into an osseofibrous *carpal tunnel*. This tunnel provides passage for the median nerve and tendons of the flexor muscles passing from the forearm to the hand. The deep fascia of the hand is continuous through the retinacula with the antebrachial fascia. The central part of the *palmar fascia* thickens to form the *palmar aponeurosis*.





(A) Axillary fascia



(B)

**Key**

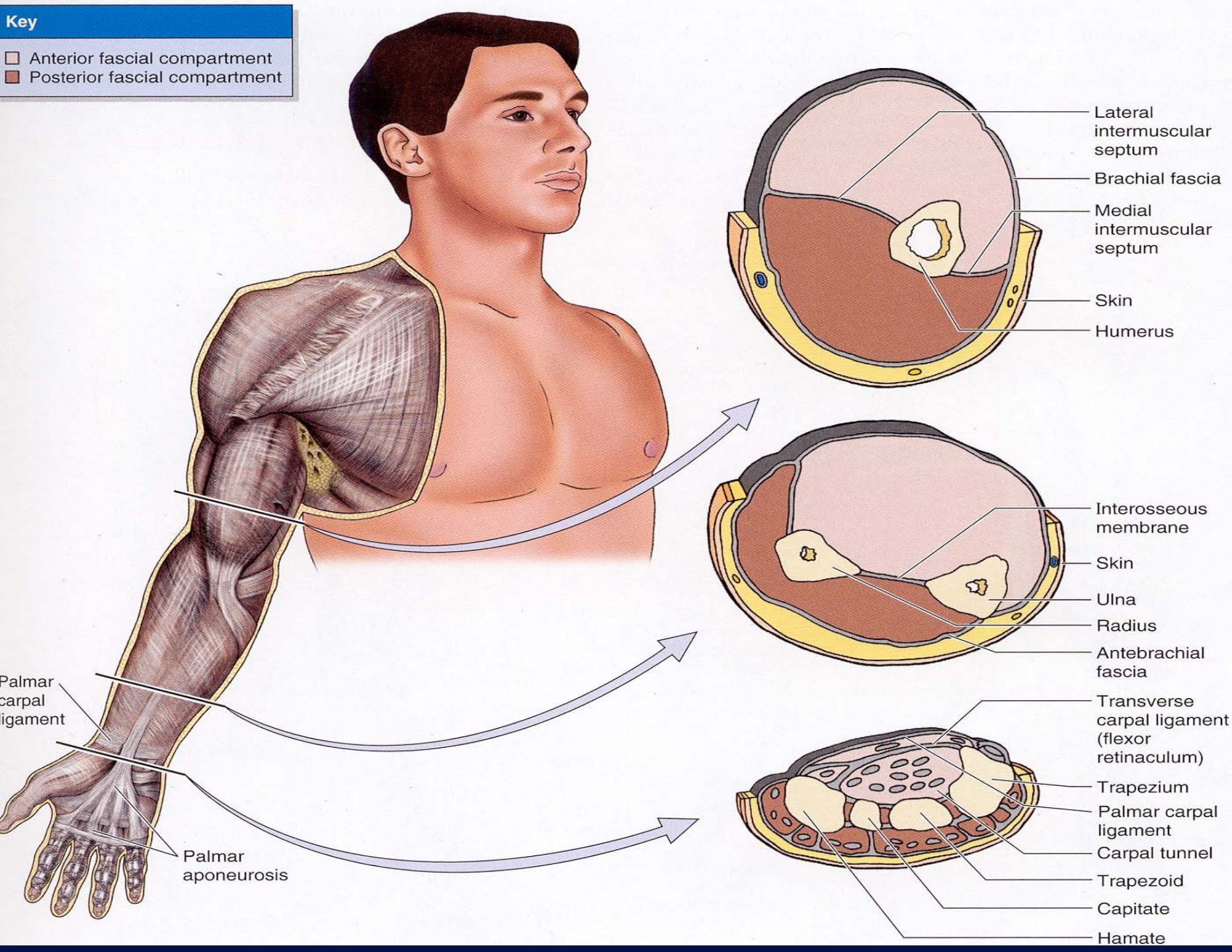
- Clavipectoral fascia
- Axillary fascia

**Figure 6.9. Axillary and clavipectoral fascia.** **A.** Axillary fascia forming the floor of the axilla (armpit), which is continuous with the pectoral fascia covering the pectoralis major. **B.** Clavipectoral and axillary fascia. The clavipectoral fascia extends between the coracoid process of the scapula, the clavicle, and the axillary fascia, enveloping the muscles of the anterior thoracic wall; this fascia and the muscles it envelops constitute the anterior wall of the axilla. The suspensory ligament of the axilla ascends from the axillary fascia and ensheaths the pectoralis minor. When the arm is abducted, traction by the suspensory ligament produces the hollow of the axilla.



**Key**

- Anterior fascial compartment
- Posterior fascial compartment



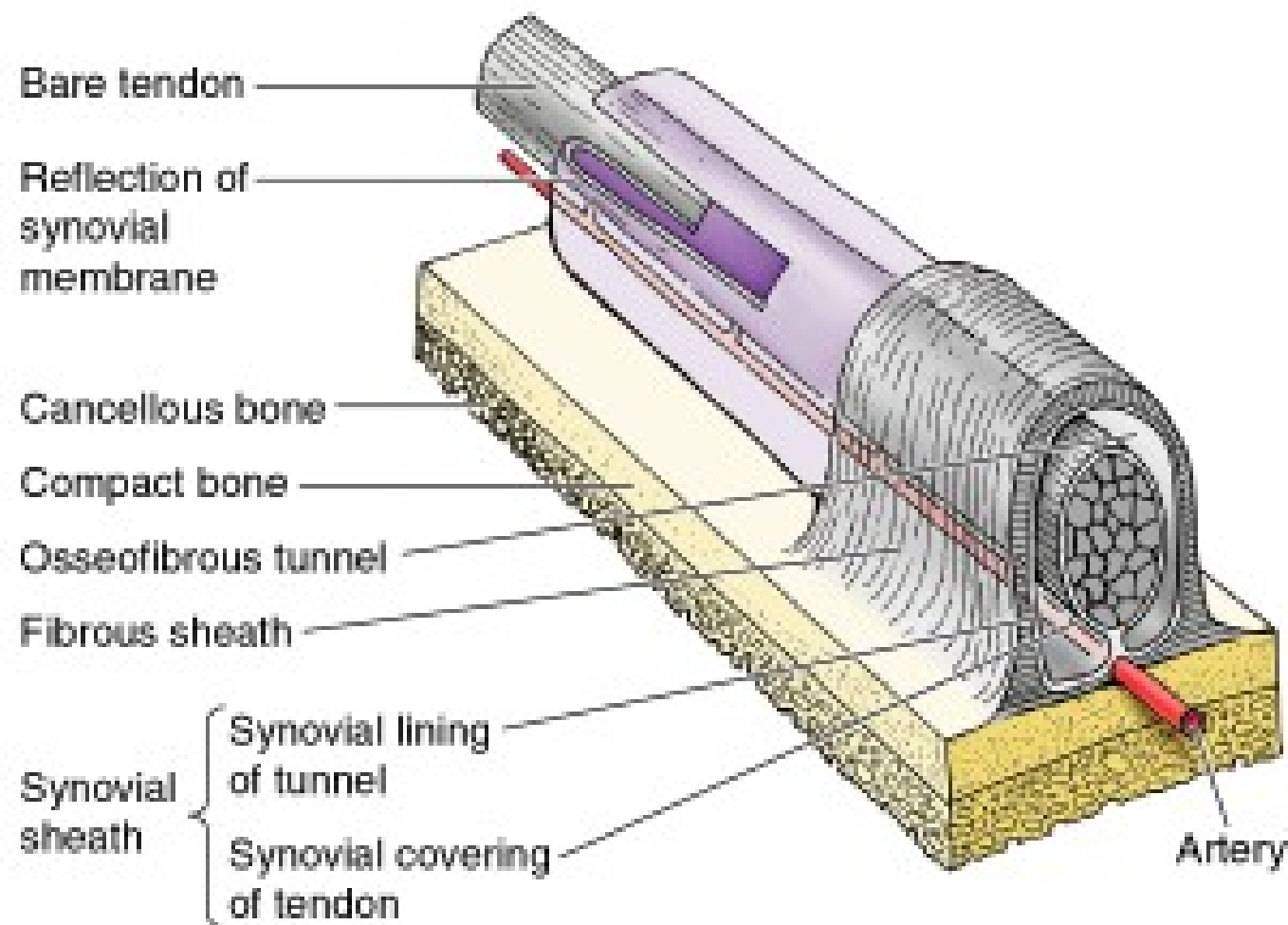


# BURSA

- A tissue capsule designed for eliminating friction wherever a muscle or tendon is liable to rub on another muscle, tendon, ligament or bone.
- It is a flattened sac & its walls are separated by only a capillary film of synovial fluid, which acts as a lubricant, allowing the walls to slide freely over each other.

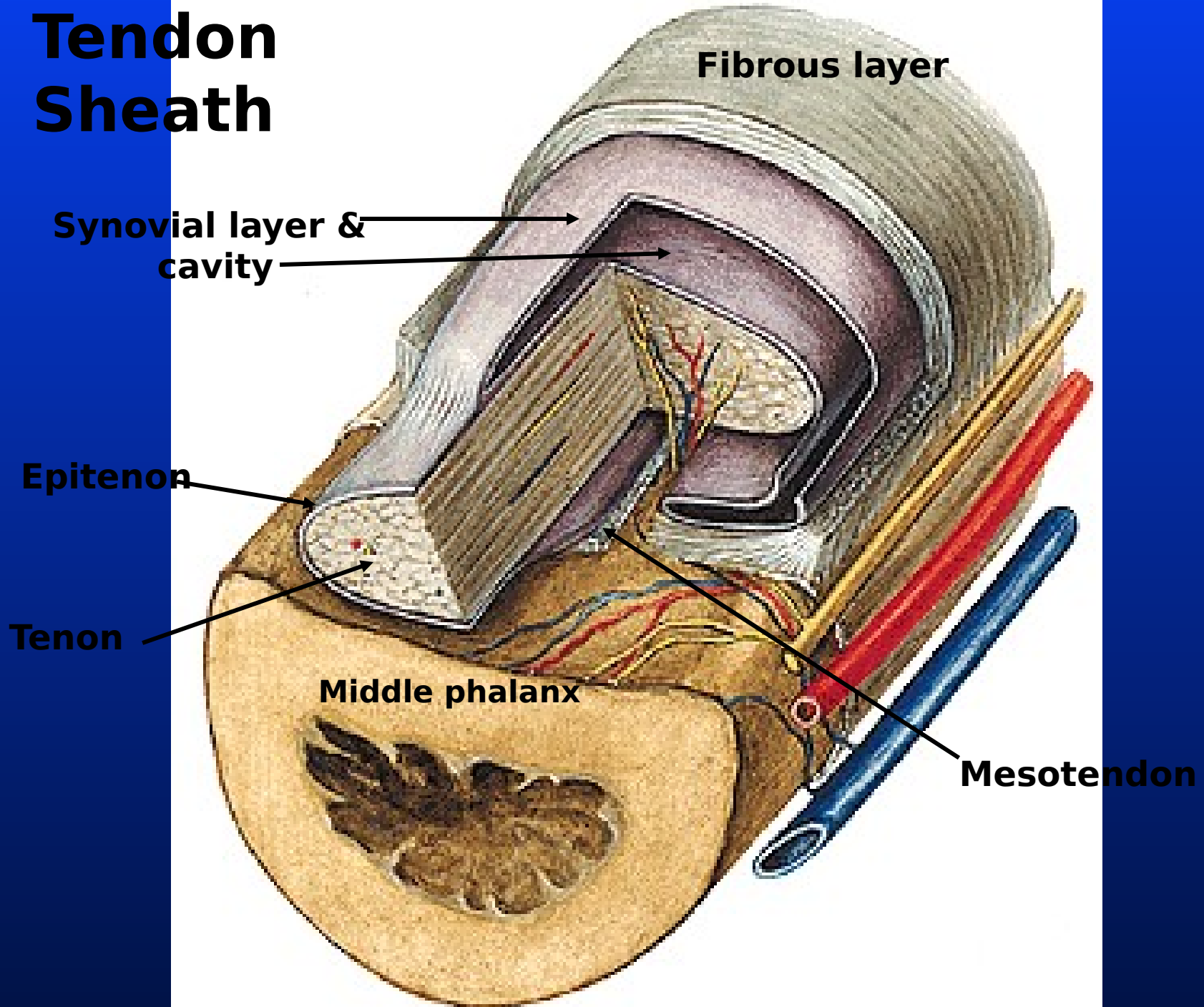
# TENDON SHEATH

6.57B, C. Palm of hand: tendons, fibrous tendon sheaths; osseofibrous tunnel of a finger.



(C)

# Tendon Sheath



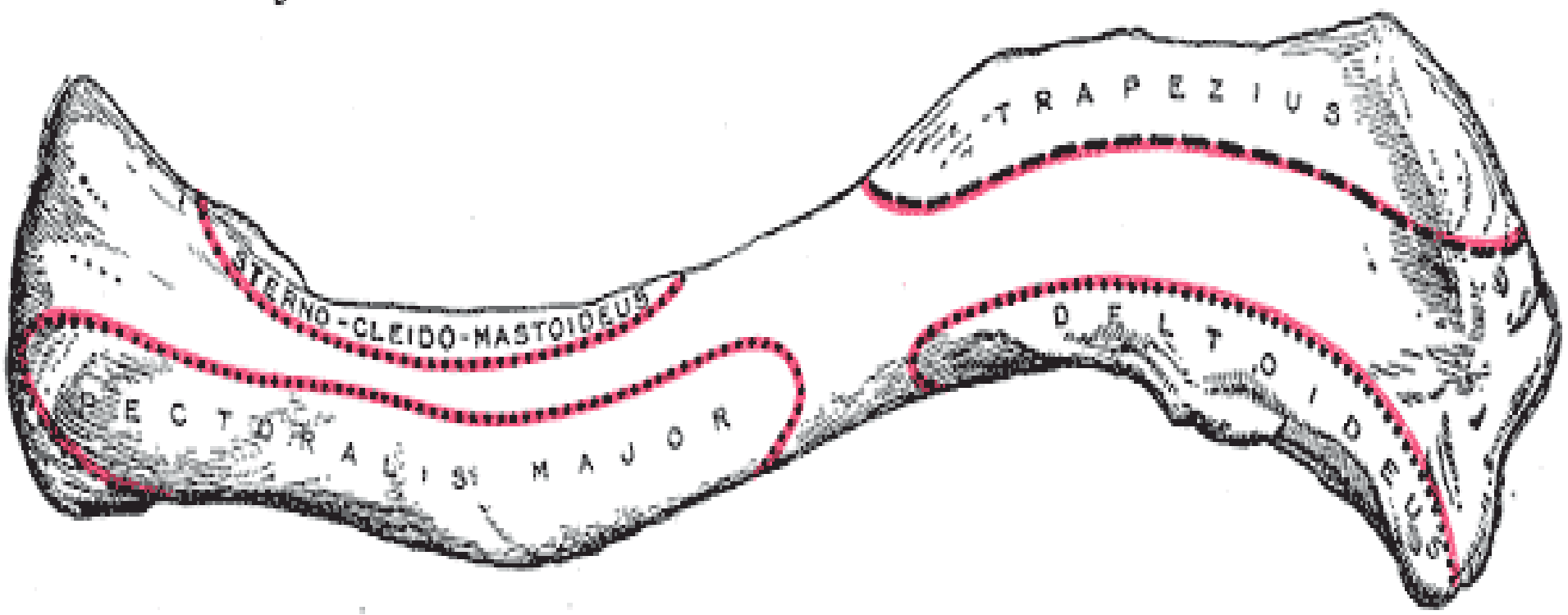
# **MUSCLES ORIGINS & INSERTIONS MARKINGS**

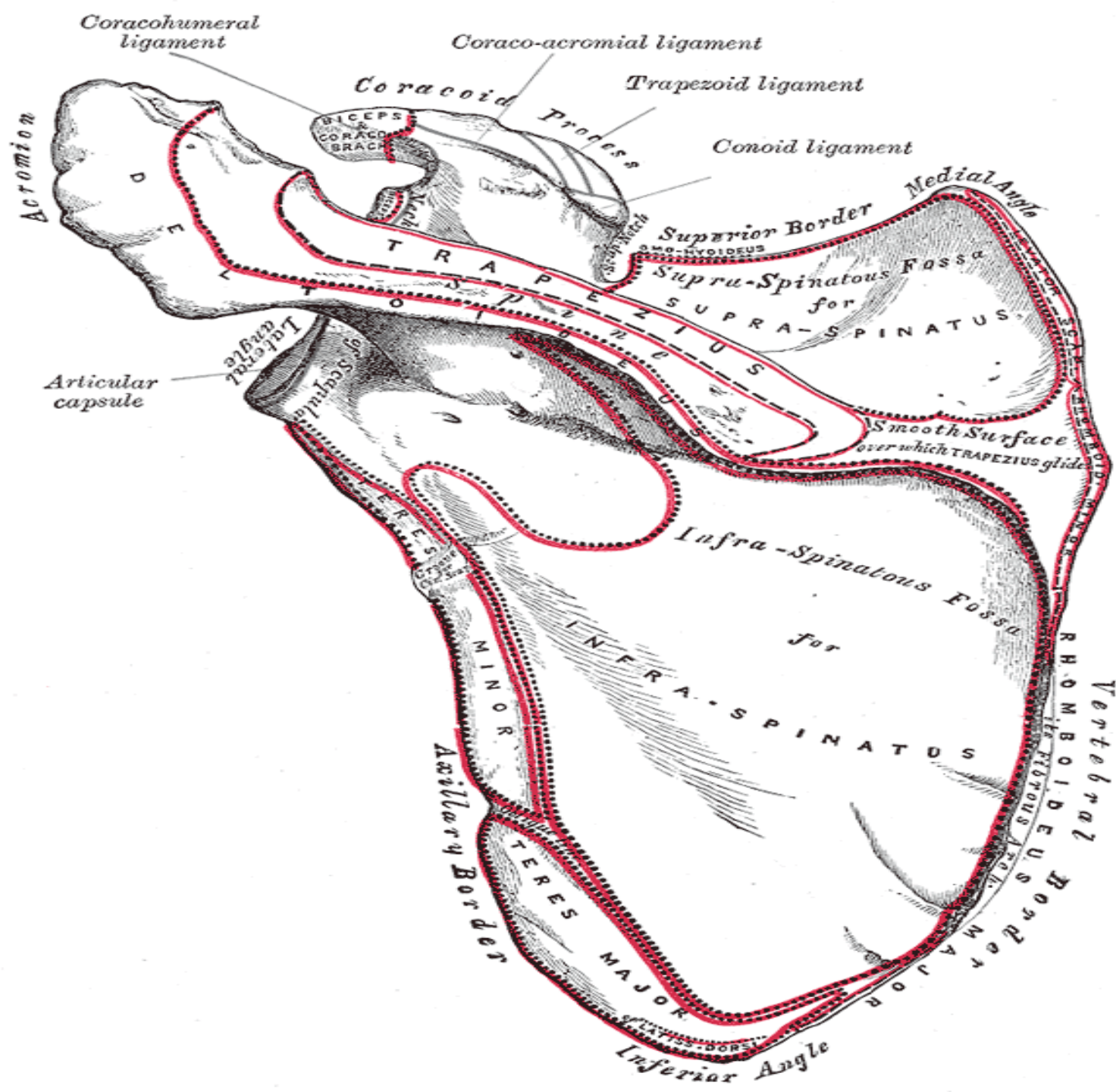
# The Pectoral (Shoulder) Girdle

- Consists of two bones:
  - **Clavicle**
  - **Scapula**
- Attaches the upper limbs to the axial skeleton
- Provides attachment points for many of the muscles that move the upper limbs

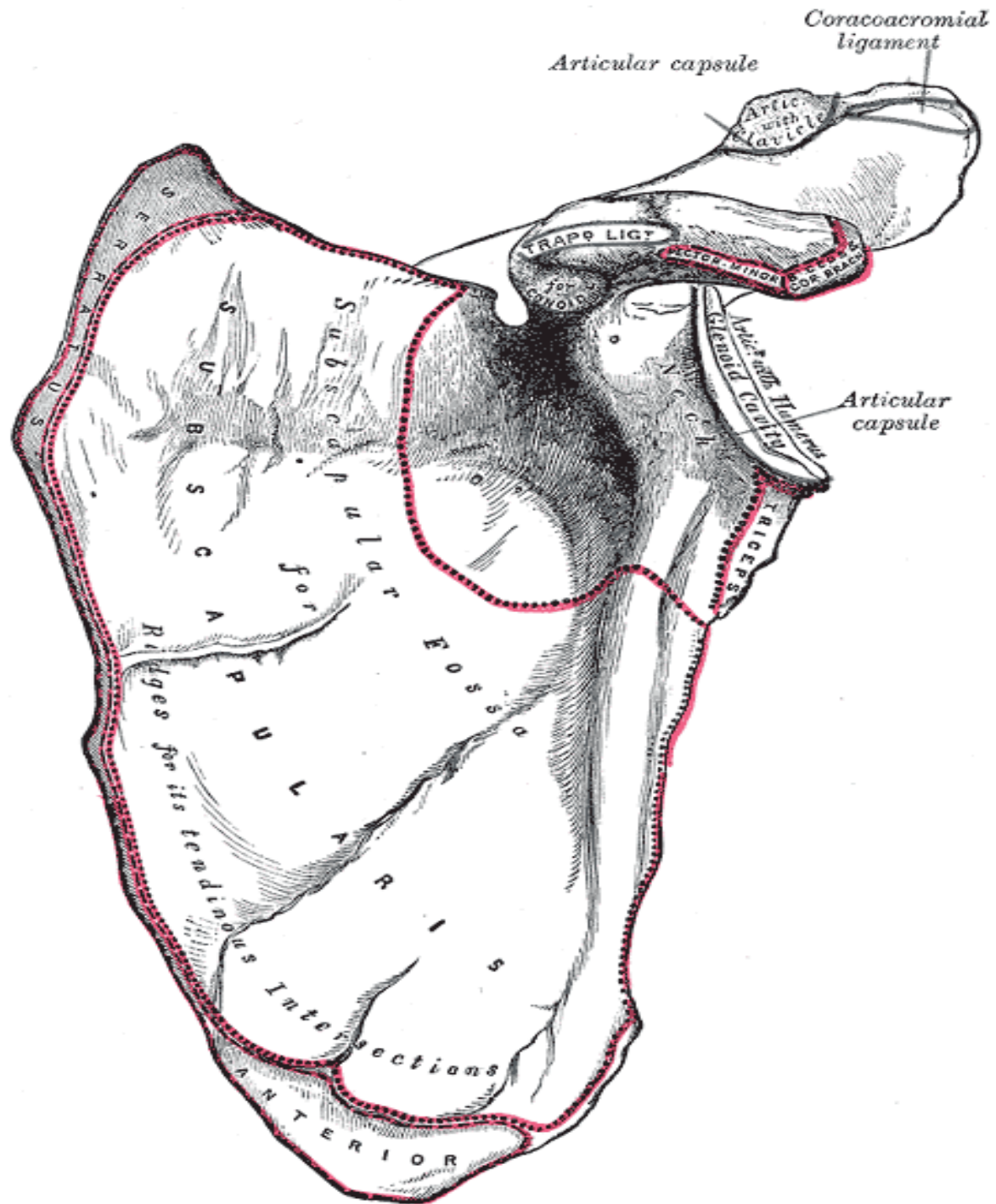
*Sternal extremity*

*Acromial extremity*



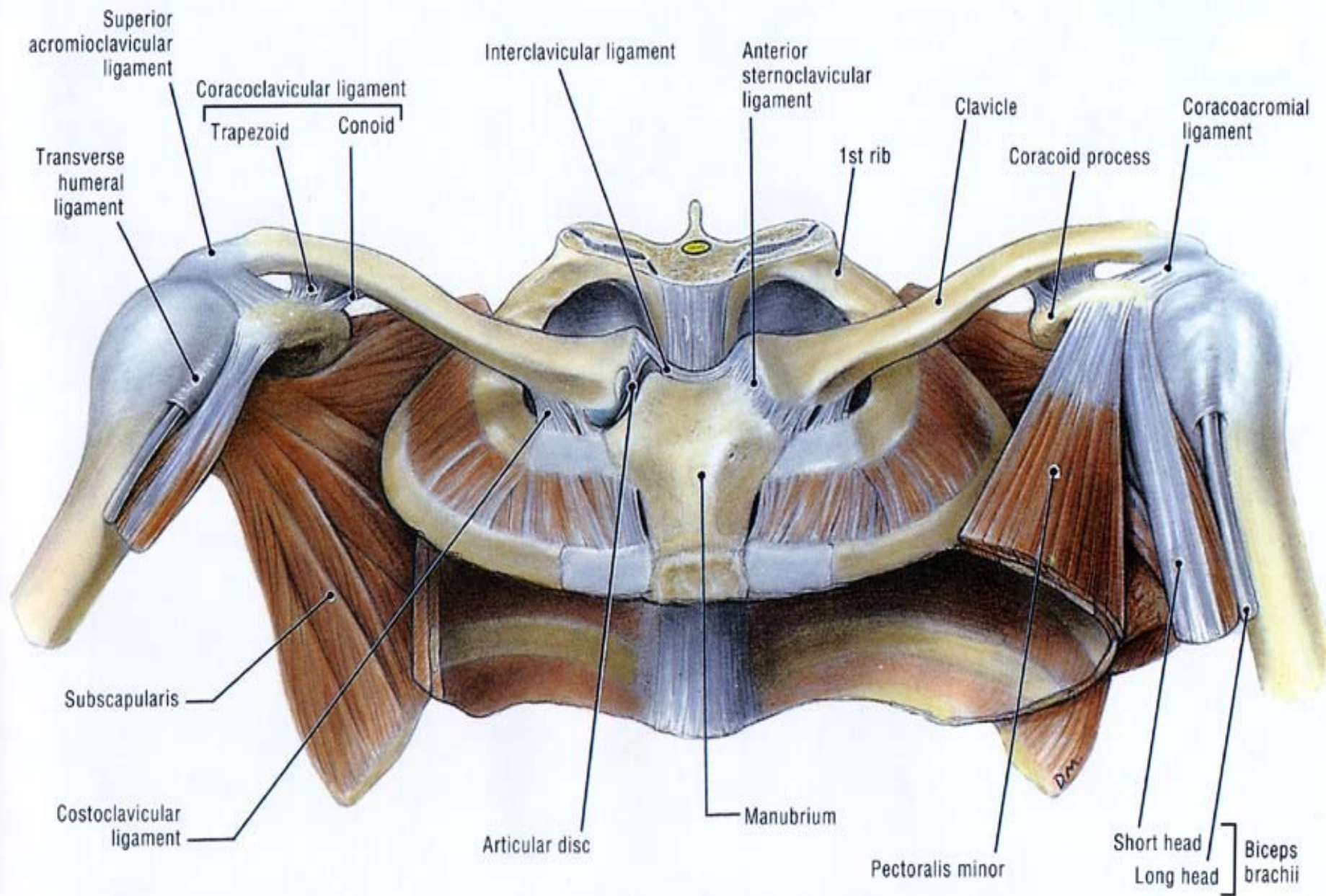






# MOVEMENTS OF THE SCAPULA

- The important movements of the pectoral girdle involve displacements of the scapula, i.e., its elevation, depressions, rotation, both forward & backward movements.
- The clavicles rotate around their own axes during scapular movements, & provide stability



**Anterosuperior view**

# MOVEMENTS OF THE SCAPULA

- Most scapular movements are promoted by the **serratus anterior** muscles anteriorly & by the **posterior** muscles.

# Superficial Muscles of the Anterior Thorax

- Most superficial thorax muscles are *extrinsic shoulder muscles*
- **Insertion** - on the ribs and vertebrae
- **Origin** - on the shoulder girdle
- **Action** - to fix the scapula to the wall of the thorax or move the scapula to effect arm movement

# **Pectoral Region**

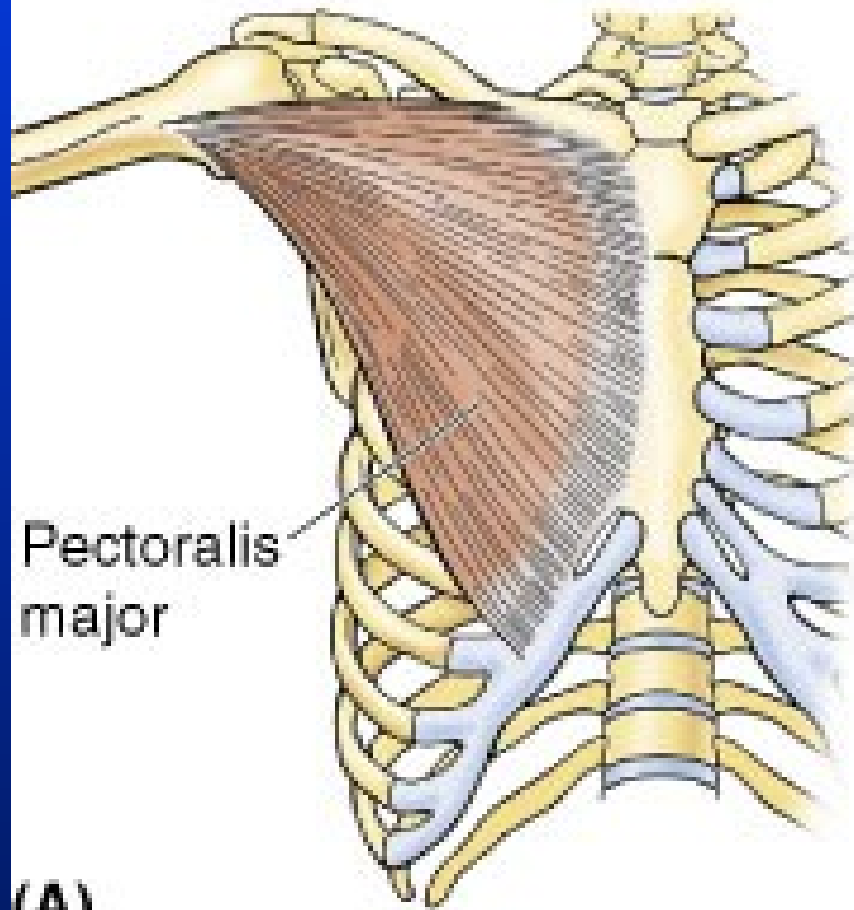
- **Pectoralis major**
- **Pectoralis minor**
- **Subclavius**
- **Serratus anterior**

– See Table 6-1, p. 688, Moore

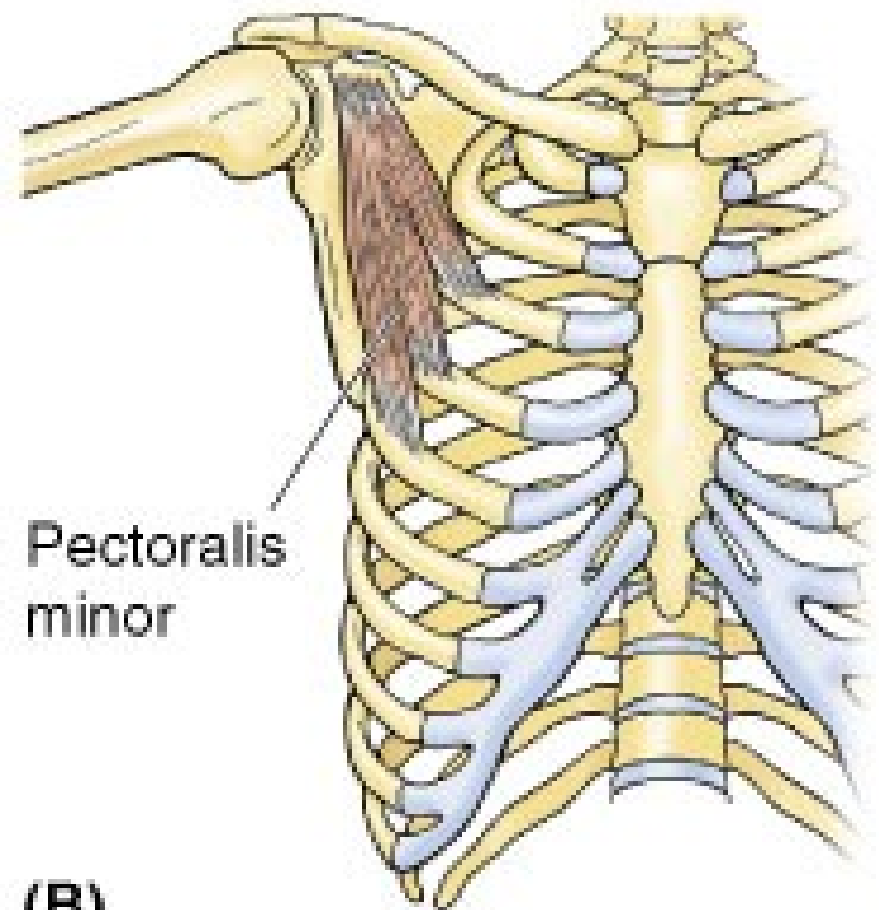


Muscle	Proximal Attachment	Distal Attachment	Innervation <sup>a</sup>	Main Action
Pectoralis major	Clavicular head: anterior surface of medial half of clavicle Sternocostal head: anterior surface of sternum, superior six costal cartilages, and aponeurosis of external oblique muscle	Lateral lip of intertubercular groove of humerus	Lateral and medial pectoral nerves; clavicular head (C5 and <b>C6</b> ), sternocostal head ( <b>C7</b> , <b>C8</b> , and T1)	Adducts and medially rotates humerus; draws scapula anteriorly and inferiorly Acting alone: clavicular head flexes humerus and sternocostal head extends it from the flexed position.
Pectoralis minor	3rd to 5th ribs near their costal cartilages	Medial border and superior surface of coracoid process of scapula	Medial pectoral nerve (C8 and T1)	Stabilizes scapula by drawing it inferiorly and anteriorly against thoracic wall
Subclavius	Junction of 1st rib and its costal cartilage	Inferior surface of middle third of clavicle	Nerve to subclavius ( <b>C5</b> and C6)	Anchors and depresses clavicle
Serratus anterior	External surfaces of lateral parts of 1st to 8th ribs	Anterior surface of medial border of scapula	Long thoracic nerve (C5, <b>C6</b> , and <b>C7</b> )	Protracts scapula and holds it against thoracic wall; rotates scapula

**Table 6.1. Anterior Thoracoappendicular Muscles**

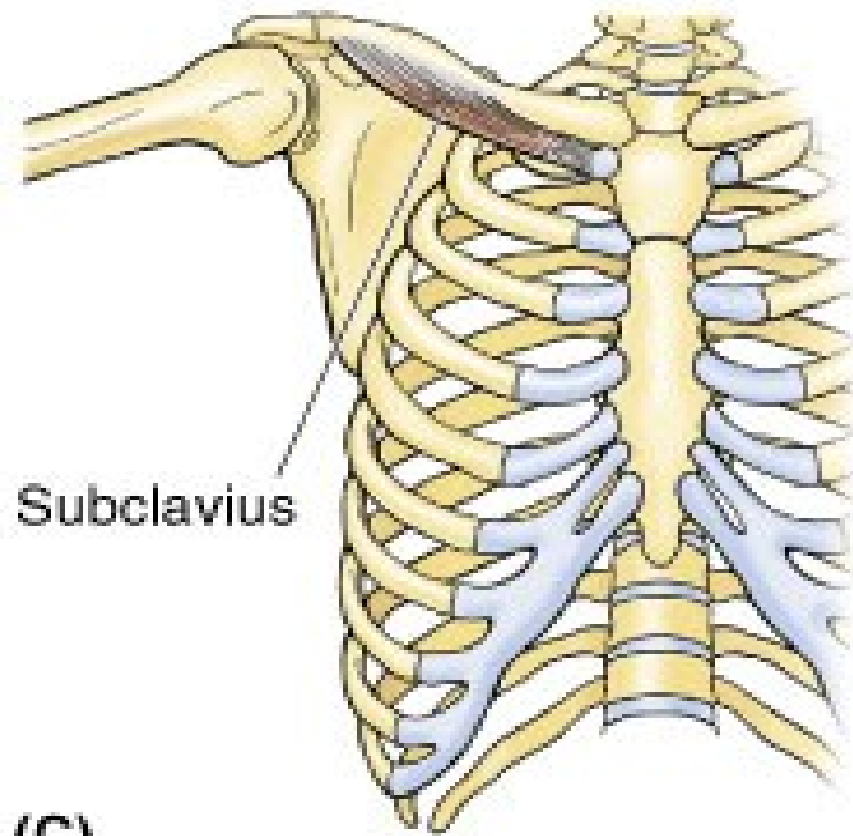


(A)

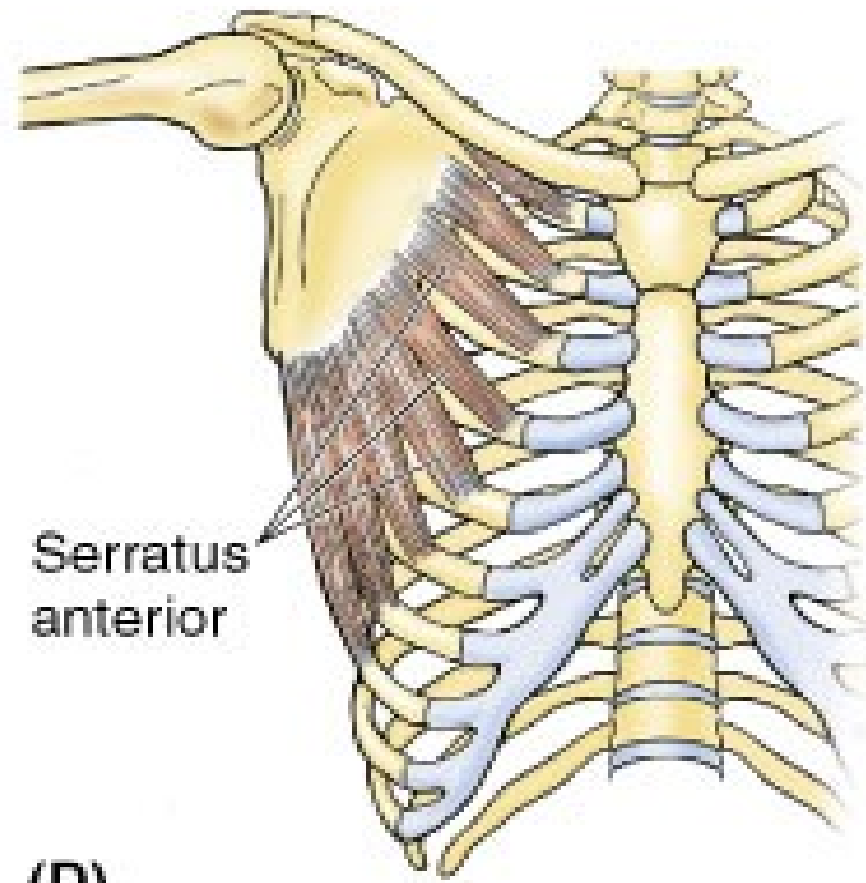


(B)



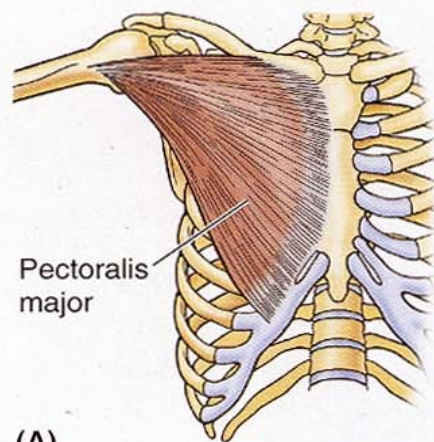


(C)

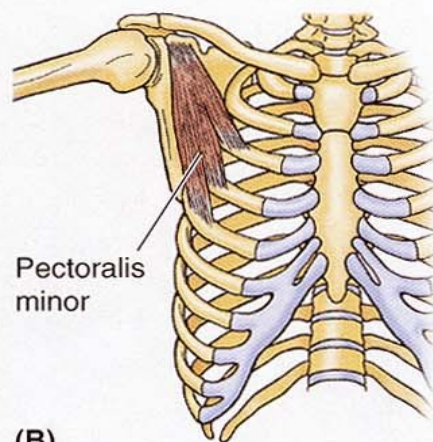


(D)

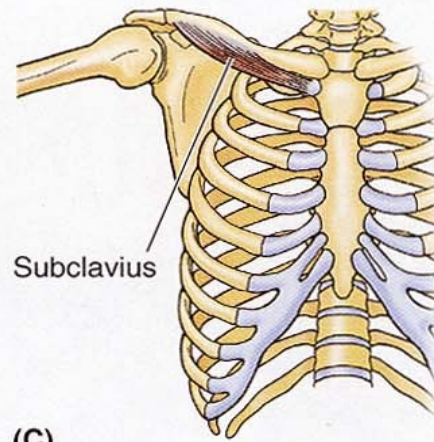
**Table 6.1. Anterior Thoracoappendicular Muscles**



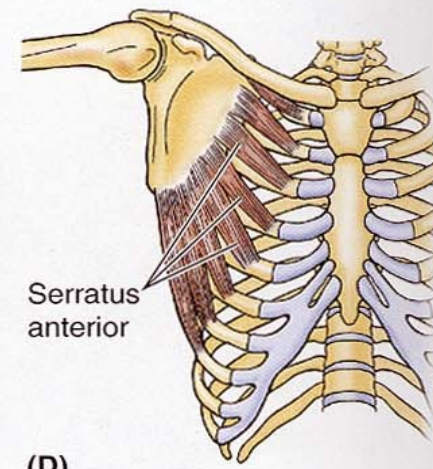
(A)



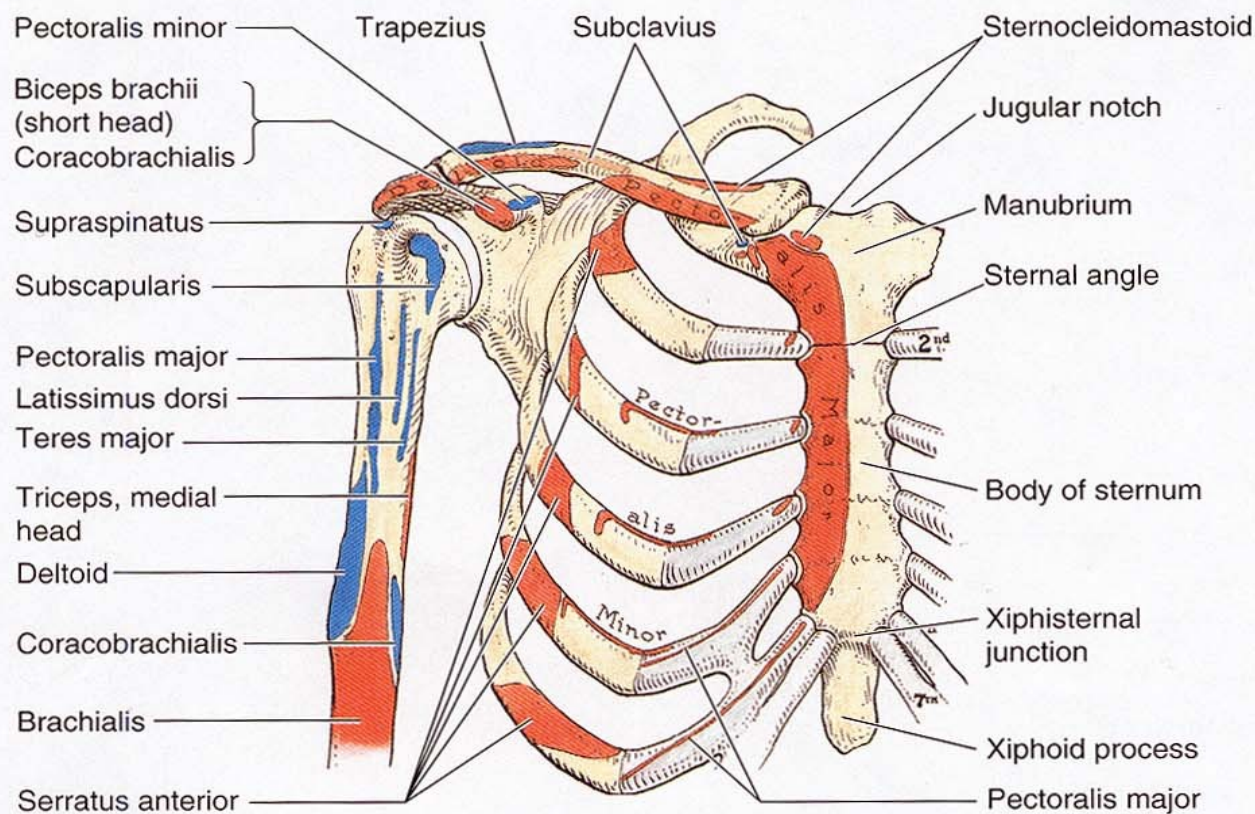
(B)



(C)



(D)

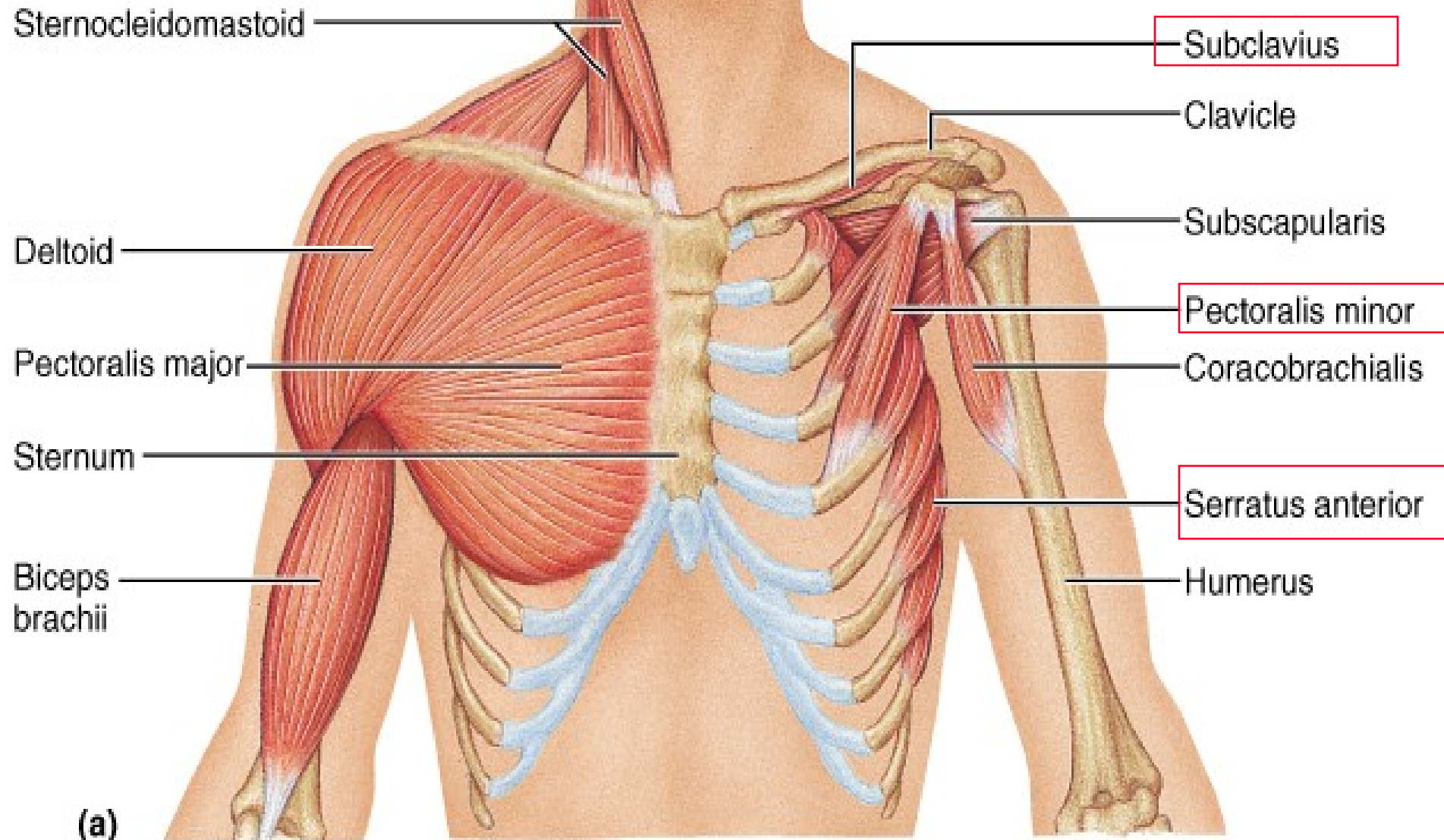


(E)

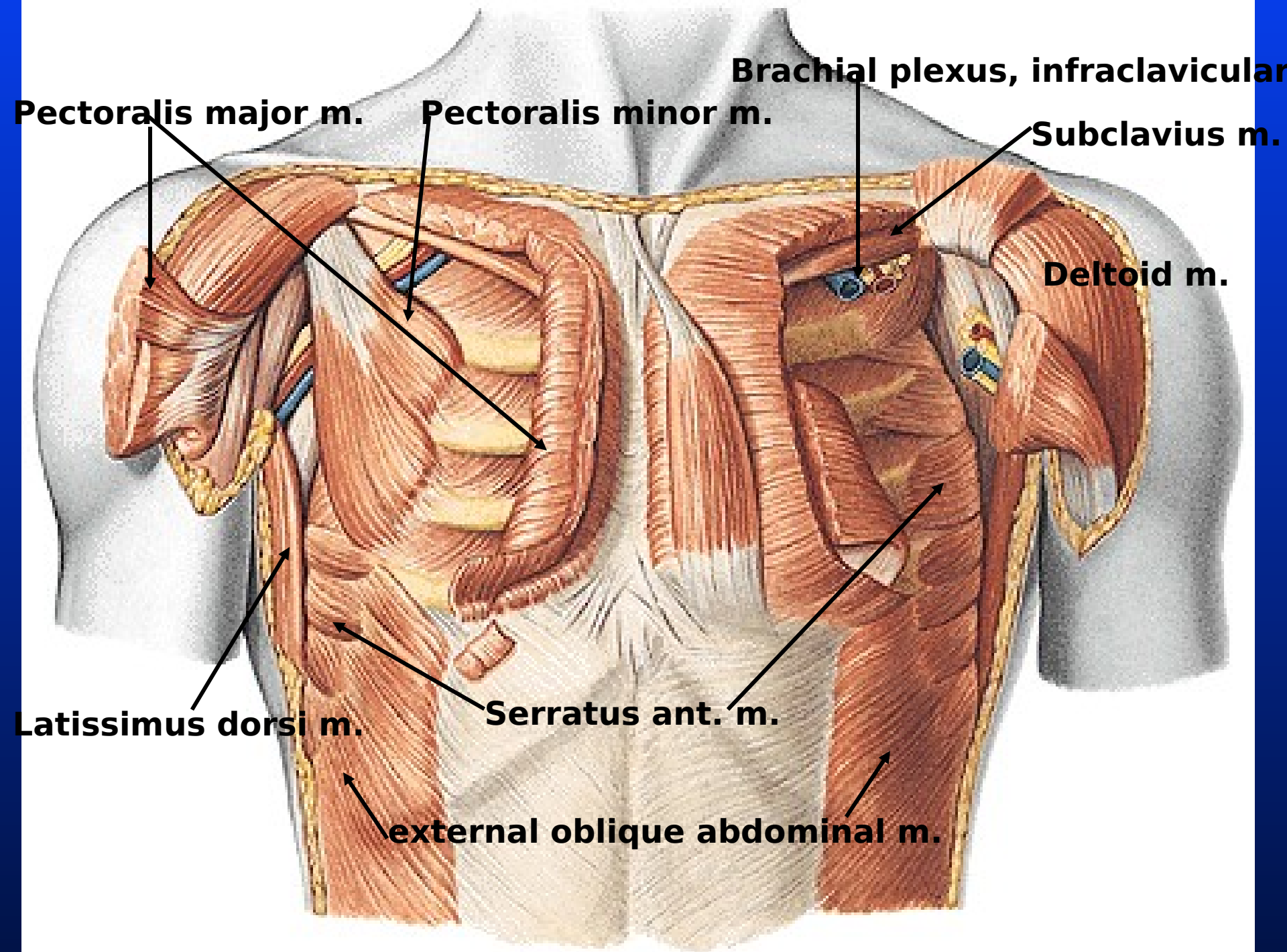
# Pectoral Girdle Insertion

- **Anterior Thorax muscles:**
  - **Pectoralis minor** - stabilizes & draws scapula forward
  - **Serratus anterior** - Prime mover to protract & hold it against thoracic wall, also rotates
  - **Subclavius** - Anchors & depresses the clavicle

## Movers of Scapula







# **Posterior Thoracoappendicul ar and Scapulohumeral Muscles**

# Posterior Thoracoappendicul ar

- The superficial and intermediate groups of ***extrinsic back muscles*** attach the superior appendicular skeleton of the upper limb to the axial skeleton in the trunk:
  - **Trapezius**
  - **Latissimus dorsi**

# Posterior Thoracoappendicul ar

- The deep *extrinsic shoulder muscles*:
  - **Levator scapulae**
  - **Rhomboid major & minor**



# Scapulohumeral Muscles

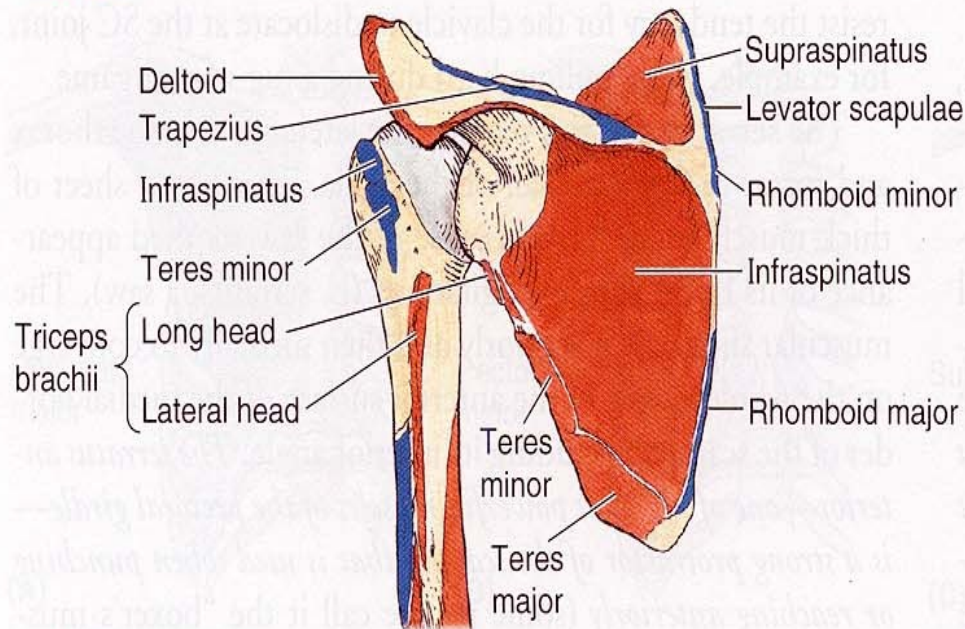
- The *intrinsic back muscles* maintain posture and control movements of the vertebral column:
  - **Deltoid**
  - **Teres major, and**
  - **Four rotator cuff muscles**

**Table 6.2.** (Continued) **Scapulohumeral and Posterior Thoracoappendicular Muscles**

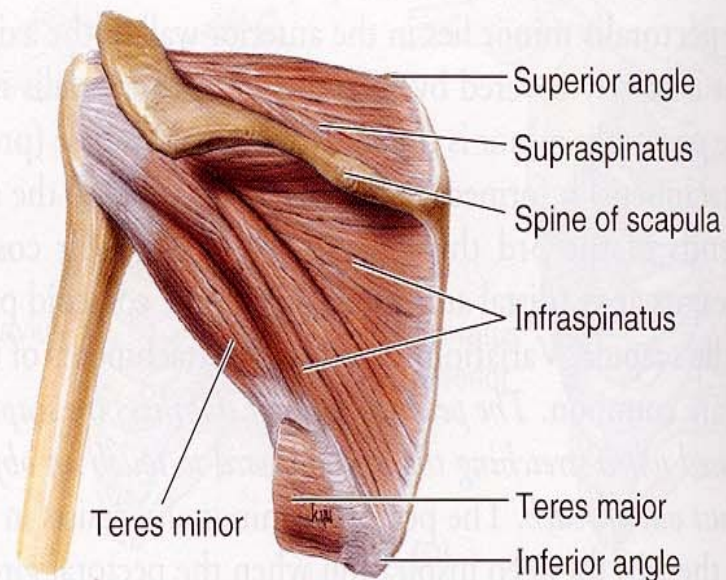
Muscle	Proximal Attachment	Distal Attachment	Innervation <sup>a</sup>	Main Action
Trapezius	Medial third of superior nuchal line; external occipital protuberance, nuchal ligament, and spinous processes of C7–T12 vertebrae	Lateral third of clavicle, acromion, and spine of scapula	Spinal root of accessory nerve (CN XI) (motor) and cervical nerves (C3 and C4) (pain and proprioception)	Elevates, retracts, and rotates scapula; superior fibers elevate, middle fibers retract, and inferior fibers depress scapula; superior and inferior fibers act together in superior rotation of scapula
Latissimus dorsi	Spinous processes of inferior 6 thoracic vertebrae, thoracolumbar fascia, iliac crest, and inferior 3 or 4 ribs	Floor of intertubercular groove of humerus	Thoracodorsal nerve ( <b>C6</b> , <b>C7</b> , and C8)	Extends, adducts, and medially rotates humerus; raises body toward arms during climbing
Levator scapulae	Posterior tubercles of transverse processes of C1–C4 vertebrae	Superior part of medial border of scapula	Dorsal scapular (C5) and cervical (C3 and C4) nerves	Elevates scapula and tilts its glenoid cavity inferiorly by rotating scapula
Rhomboid minor and major	<i>Minor:</i> nuchal ligament and spinous processes of C7 and T1 vertebrae <i>Major:</i> spinous processes of T2–T5 vertebrae	Medial border of scapula from level of spine to inferior angle	Dorsal scapular nerve (C4 and <b>C5</b> ) rotate	Retract scapula and rotate it to depress glenoid cavity; fix scapula to thoracic wall
Deltoid	Lateral third of clavicle, acromion, and spine of scapula	Deltoid tuberosity of humerus	Axillary nerve ( <b>C5</b> and C6)	Anterior part: flexes and medially rotates arm Middle part: abducts arm Posterior part: extends and laterally rotates arm
Supraspinatus <sup>b</sup>	Supraspinous fossa of scapula	Superior facet on greater tubercle of humerus	Suprascapular nerve (C4, <b>C5</b> , and C6)	Initiates and assists deltoid in abduction of arm and acts with rotator cuff muscles <sup>b</sup>
Infraspinatus <sup>b</sup>	Infraspinous fossa of scapula	Middle facet on greater tubercle of humerus	Suprascapular nerve ( <b>C5</b> and C6)	Laterally rotate arm; help to hold humeral head in glenoid cavity of scapula
Teres minor <sup>b</sup>	Superior part of lateral border of scapula	Inferior facet on greater tubercle of humerus	Axillary nerve ( <b>C5</b> and C6)	
Teres major	Dorsal surface of inferior angle of scapula	Medial lip of intertubercular groove of humerus	Lower subscapular nerve ( <b>C6</b> and C7)	Adducts and medially rotates arm
Subscapularis <sup>b</sup>	Subscapular fossa	Lesser tubercle of humerus	Upper and lower subscapular nerves (C5, <b>C6</b> , and C7)	Medially rotates arm and adducts it; helps to hold humeral head in glenoid cavity



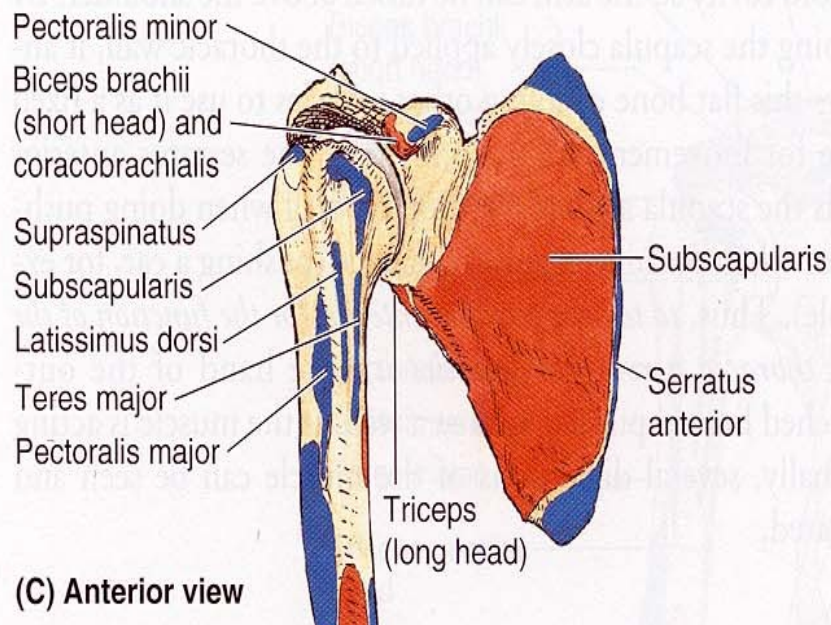
**Table 6.2. Scapulohumeral and Posterior Thoracoappendicular Muscles**



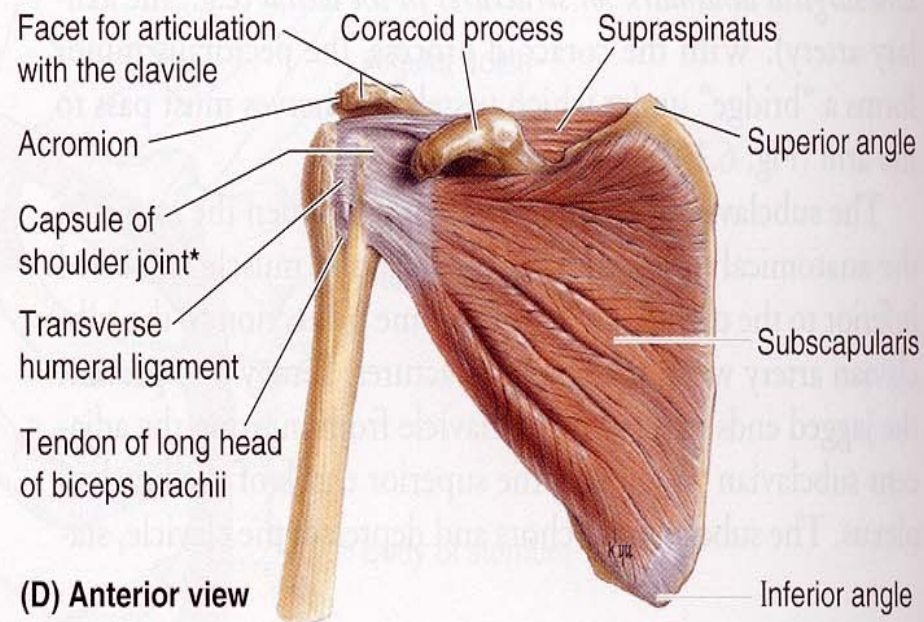
**(A) Posterior view**



**(B) Posterior view**



**(C) Anterior view**

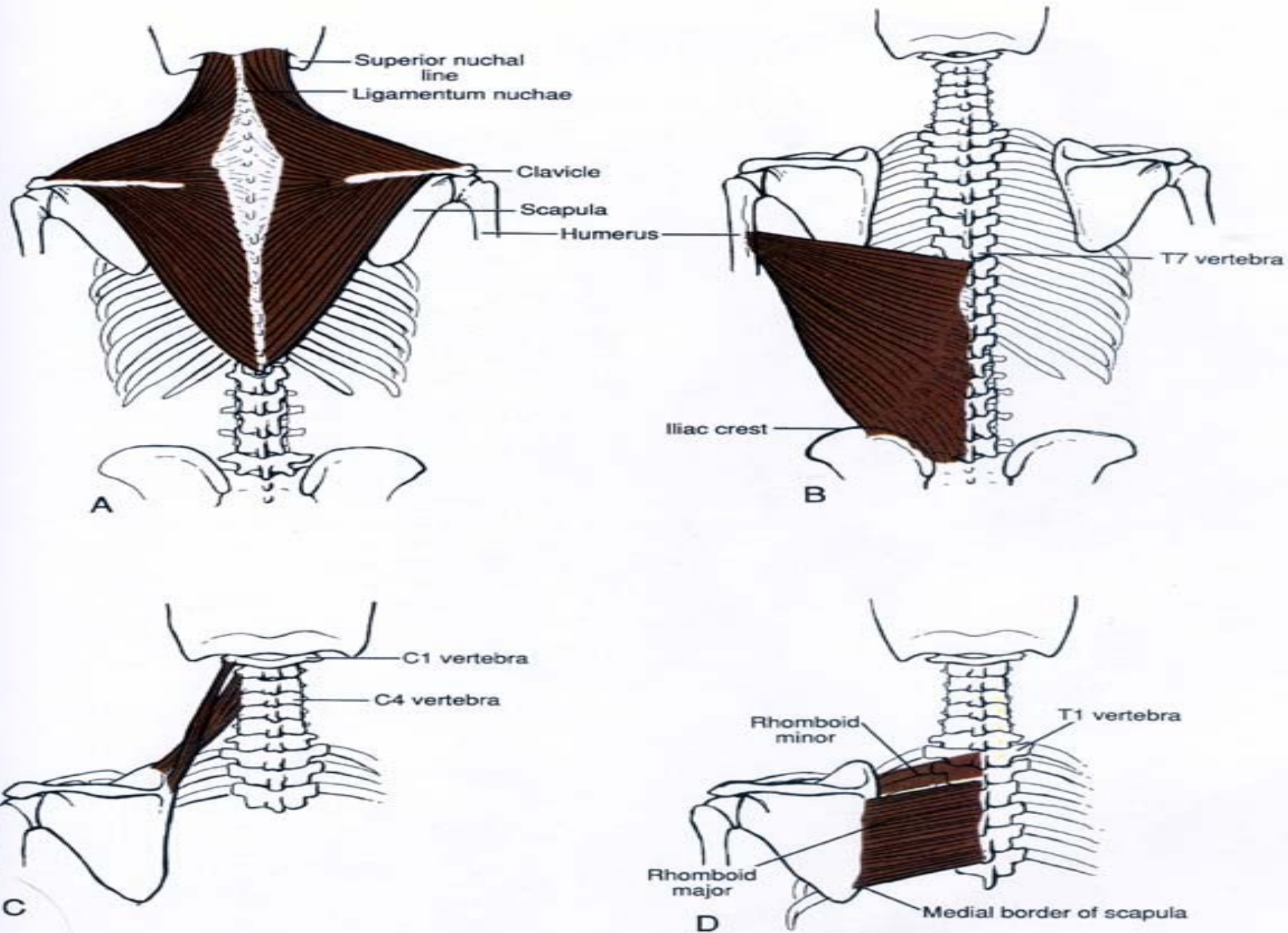


**(D) Anterior view**

# **Extrinsic Muscles of the Posterior Thorax**

- **Trapezius**
- **Levator scapulae**
- **Rhomboids major**
- **Rhomboids minor**
  - Insertion along vertebrae from the occipital bone to the iliac crest





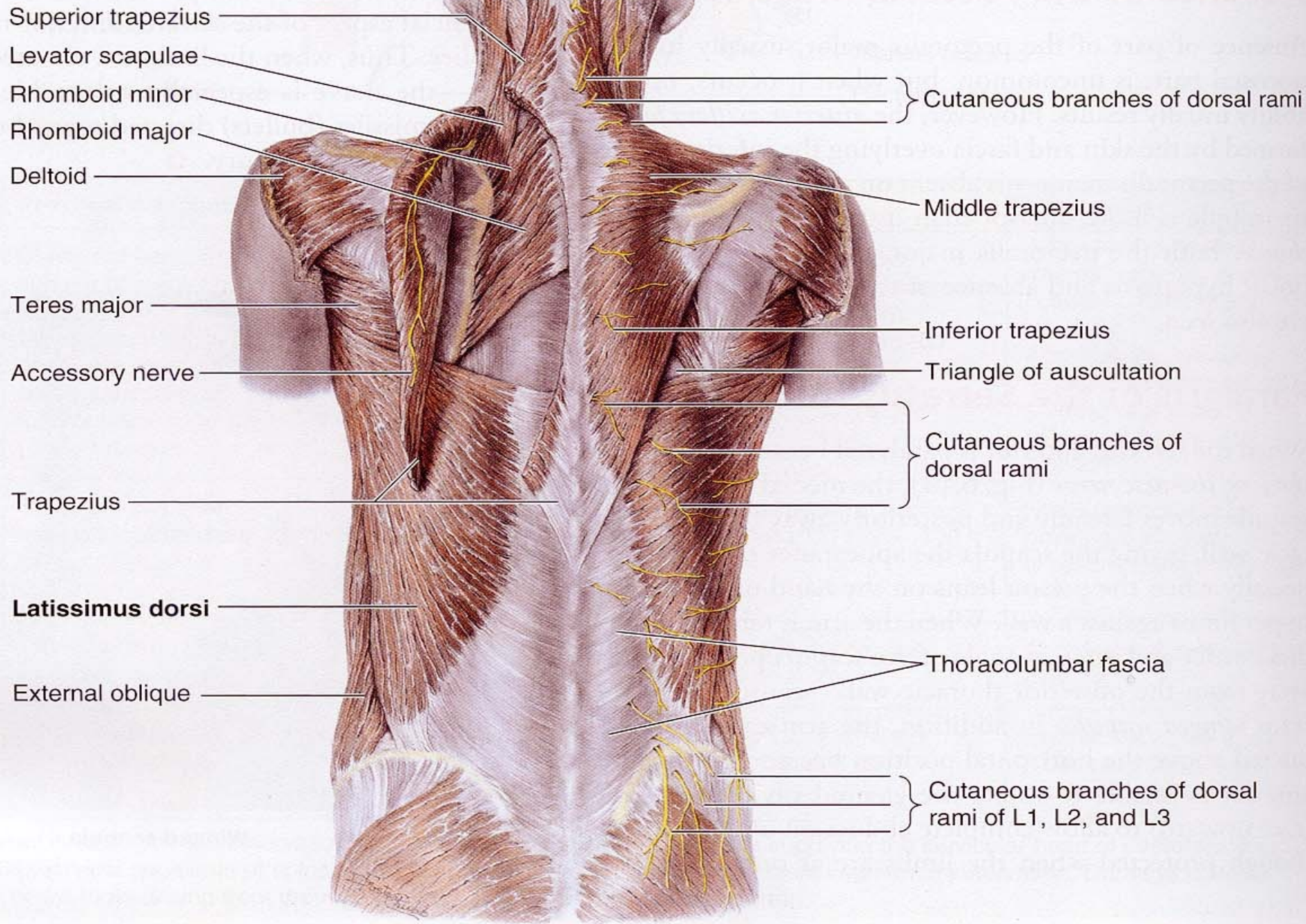
**Figure 6-36.** Muscles connecting the upper limb to the vertebral column. *A*, Trapezius. *B*, Latissimus dorsi. *C*, Levator scapulae. *D*, Rhomboid minor and major.

# **Superficial Muscles**

## **Movement of Scapula**

- Posterior Thorax muscles:
  - **Trapezius**
  - **Levator scapulae**
  - **Rhomboids**
- Work in concert with Trapezius
- All have insertion on scapula





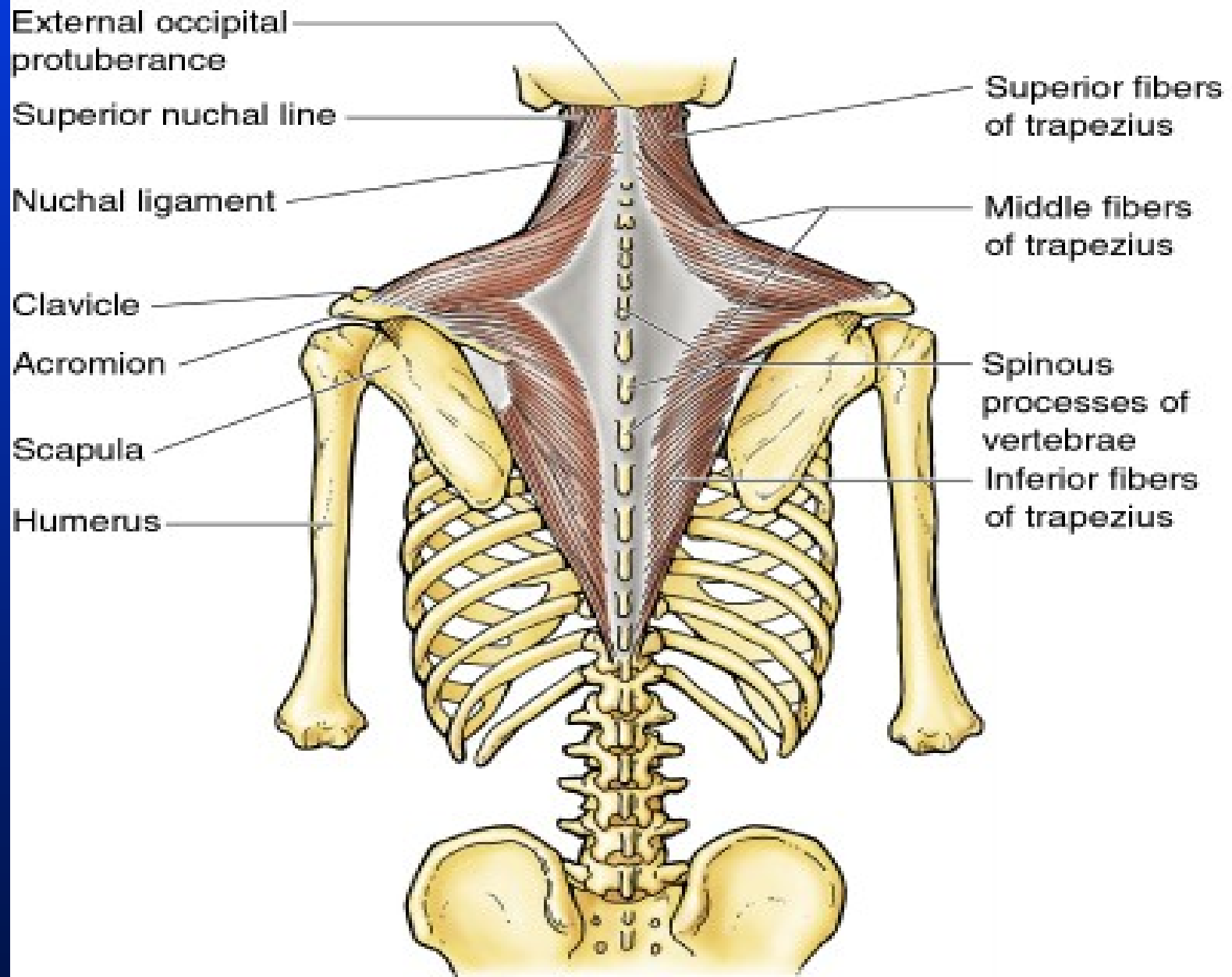
# **Extrinsic Muscles of the Posterior Thorax**

- **Trapezius**

- **I** = acromion & spine of scapula & lateral third of clavicle
- **F** = PM elevator, stabilizes, retracts, & rotates scapula



## 6.15. Trapezius muscle.

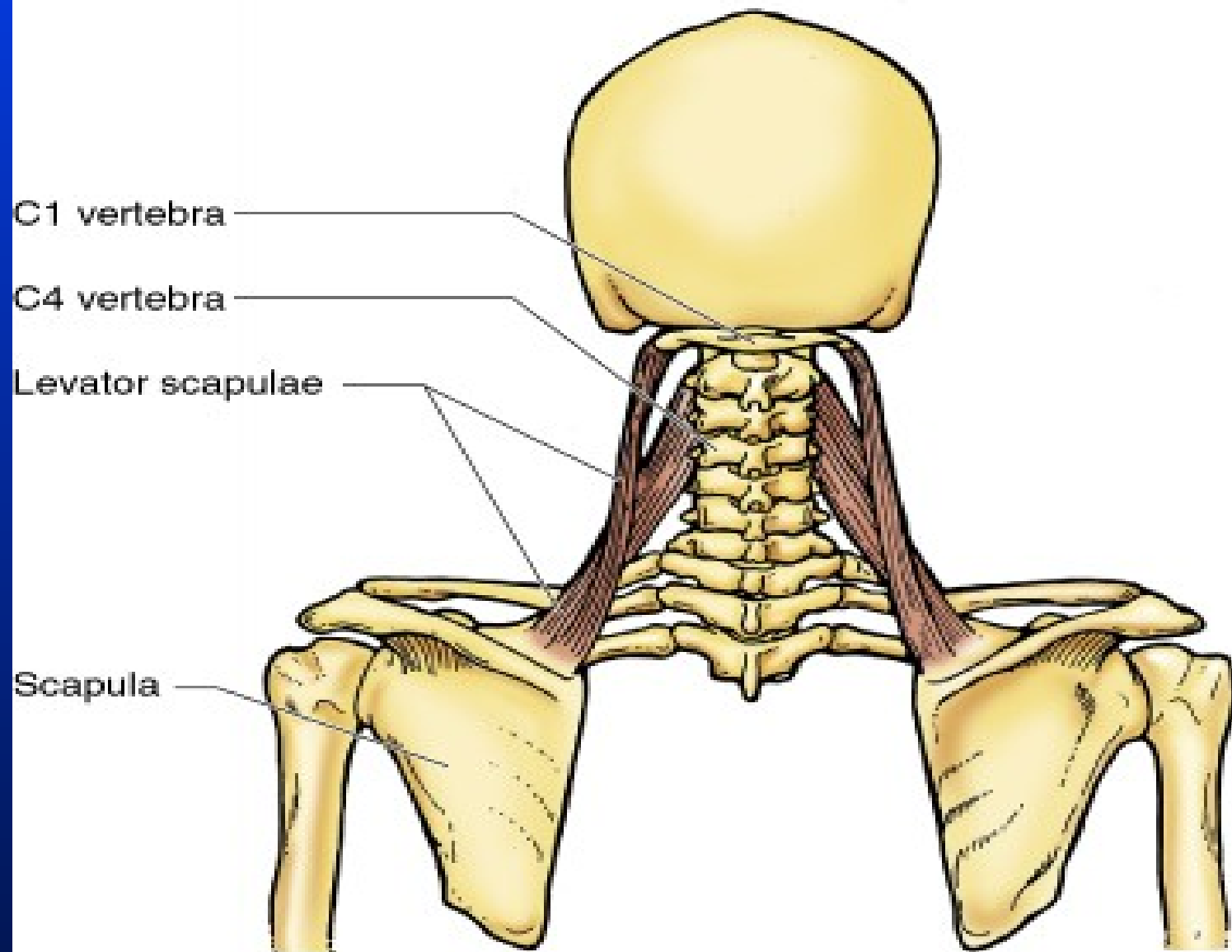


# **Extrinsic Muscles of the Posterior Thorax**

- **Levator scapulae**

- **I** = acromion & spine of scapula & lateral third of clavicle
- **F** = PM elevator, stabilizes, elevates, retracts, & rotates scapula

6.17. Levator scapulae muscles, posterior view.

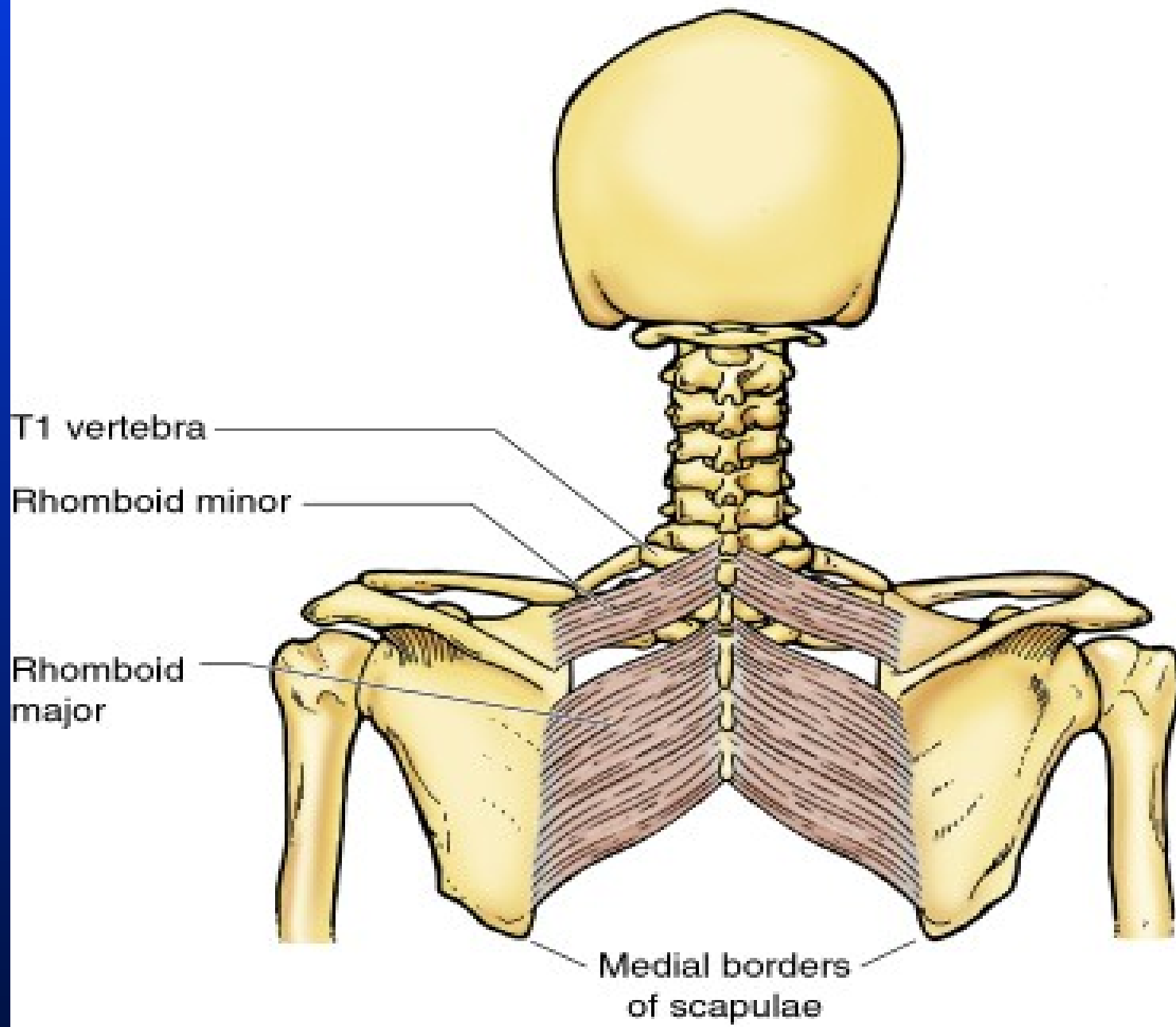


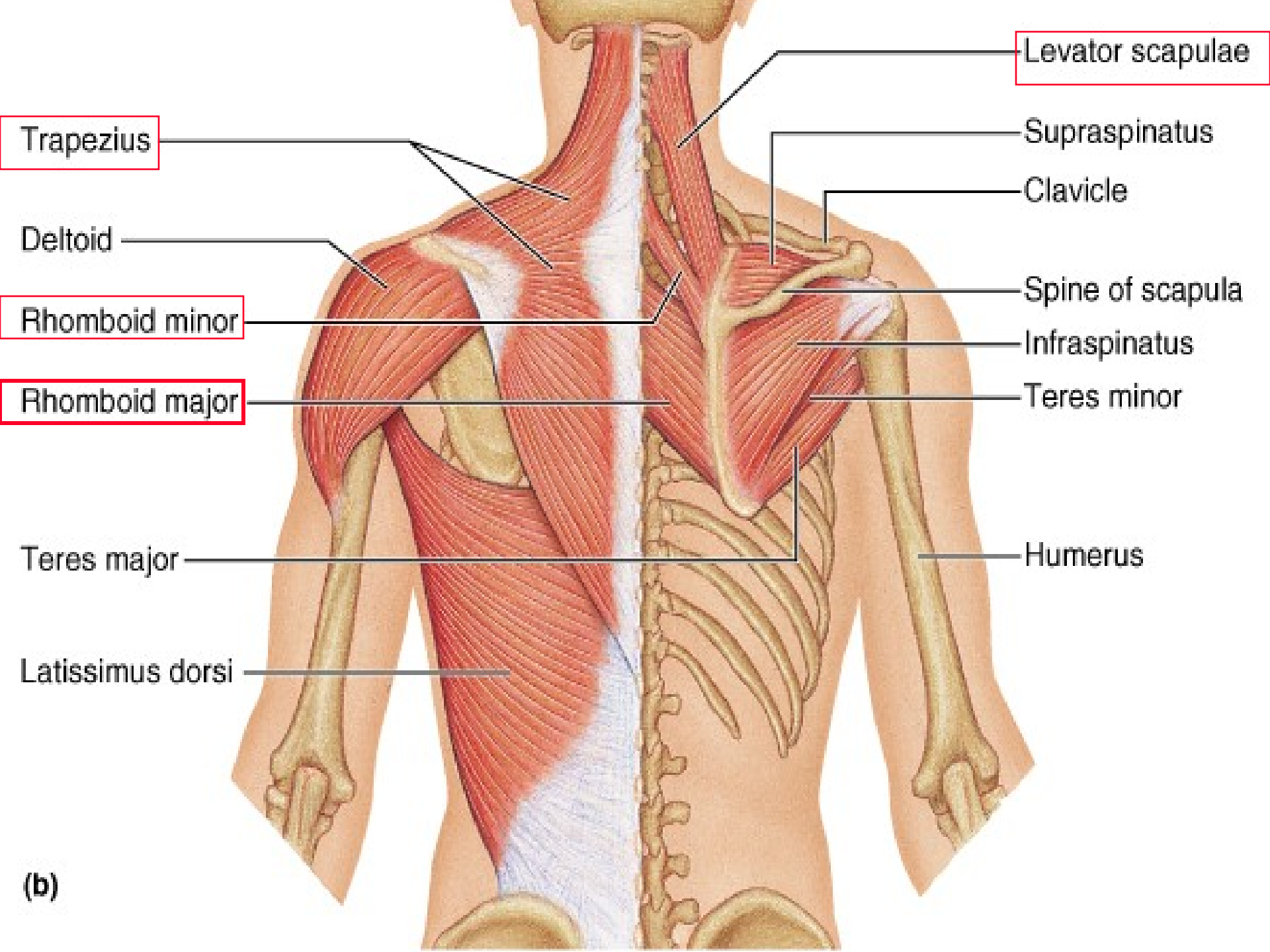
posterior view

# **Extrinsic Muscles of the Posterior Thorax**

- **Rhomboids major & minor**
  - **I** = medial border of scapula
  - **F** = stabilizes, retracts scapula & rotates scapulae so that glenoid cavity rotates downward

6.18. Rhomboid muscles, posterior view.





(b)

# **Muscles Crossing the Shoulder Joint: Movement of the Arm**

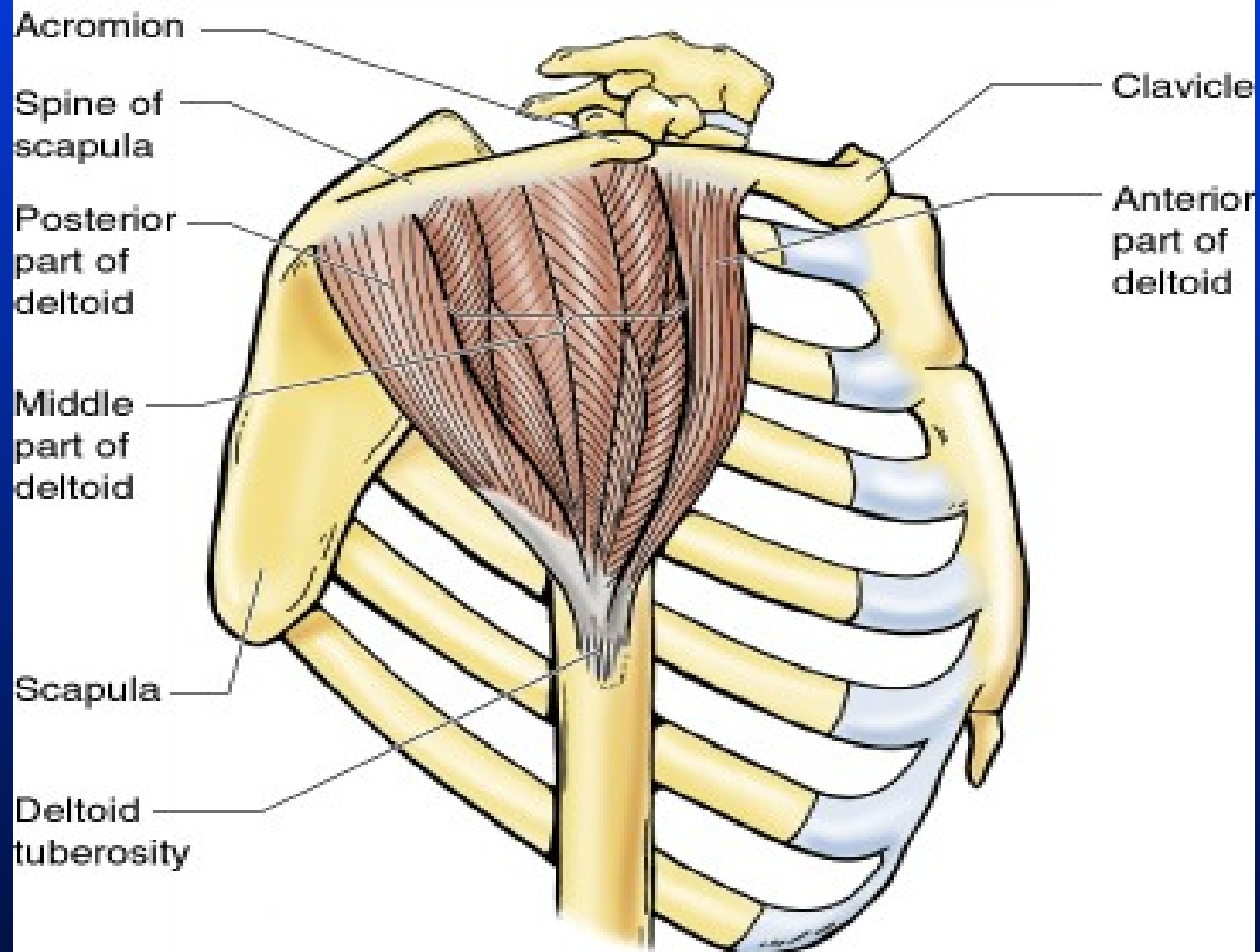
- Of the nine muscles, only the superficial:
  - **Pectoralis major**
  - **Latissimus dorsi**
  - **Deltoid**are prime movers of arm movement.

# Deltoid

- Covers the glenohumeral (shoulder) joint and forms the rounded contour of the shoulder.
  - **O** = Lateral third of clavicle, acromion, & spine
  - **I** = Deltoid tuberosity of humerus
  - **F** = The **middle** portion is the principal abductor of the arm; the **anterior** part flexes and medially rotates the arm, and the **posterior** part extends and laterally rotates the arm.



## 6.19. Deltoid muscle.



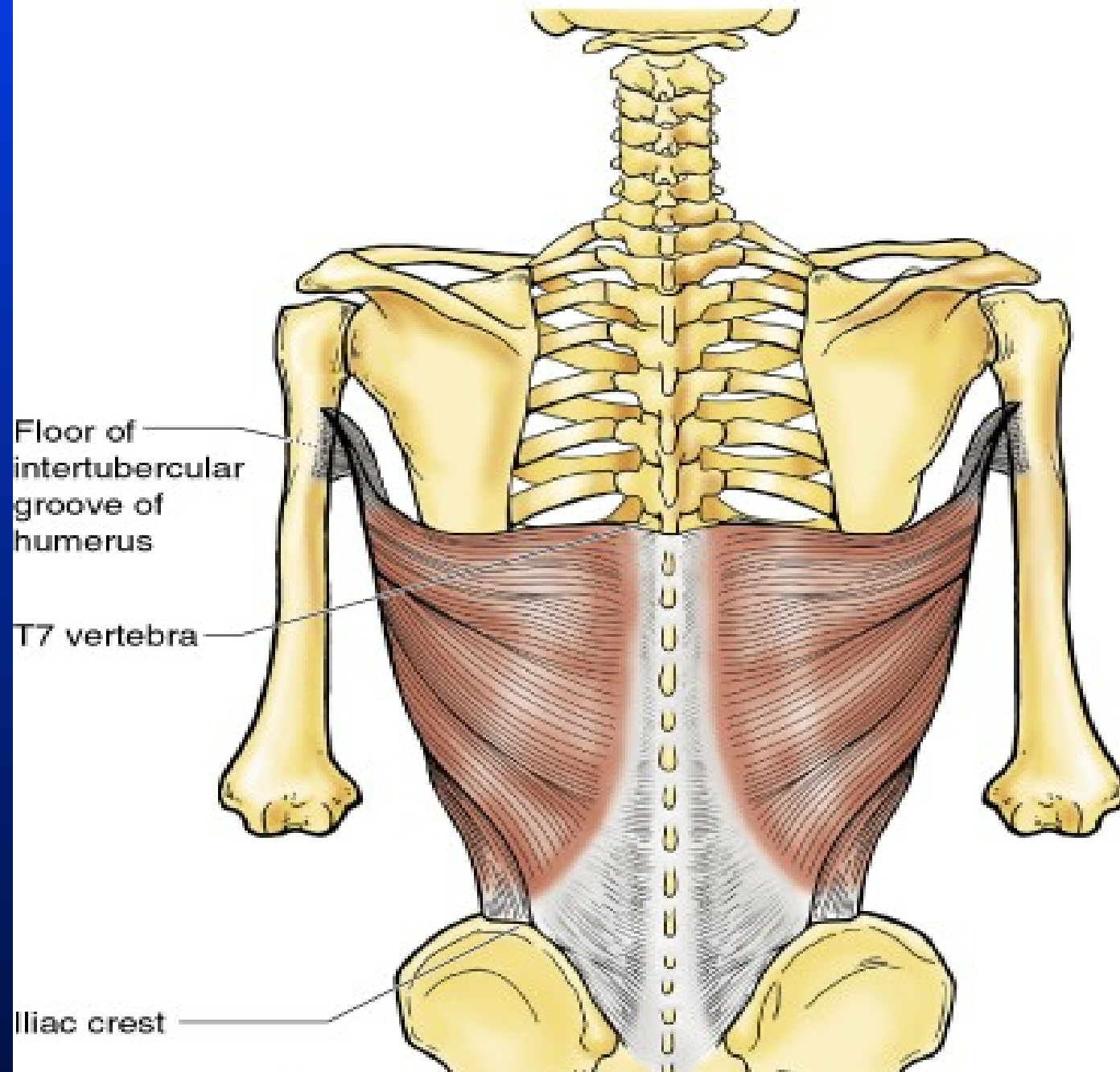
## 6.20. Testing of the deltoid muscle.



# Latissimus dorsi

- **O** = Spinous process of the inferior 6 thoracic vertebrae, thoracolumbar fascia, iliac crest, and inferior 3 or 4 ribs
- **I** = Floor of the Intertubercular groove of humerus
- **F** = Extends, adducts, and medially rotates humerus; raises body toward arms during **climbing**.

6.16. Latissimus dorsi muscle.



# Pectoralis major

- **O** = Clavicular Head & Sternocostal Region
- **I** = Intertubercular groove of humerus
- **F** = PM of arm flexion, adducts & med. Rotates humerus

### Anterior View



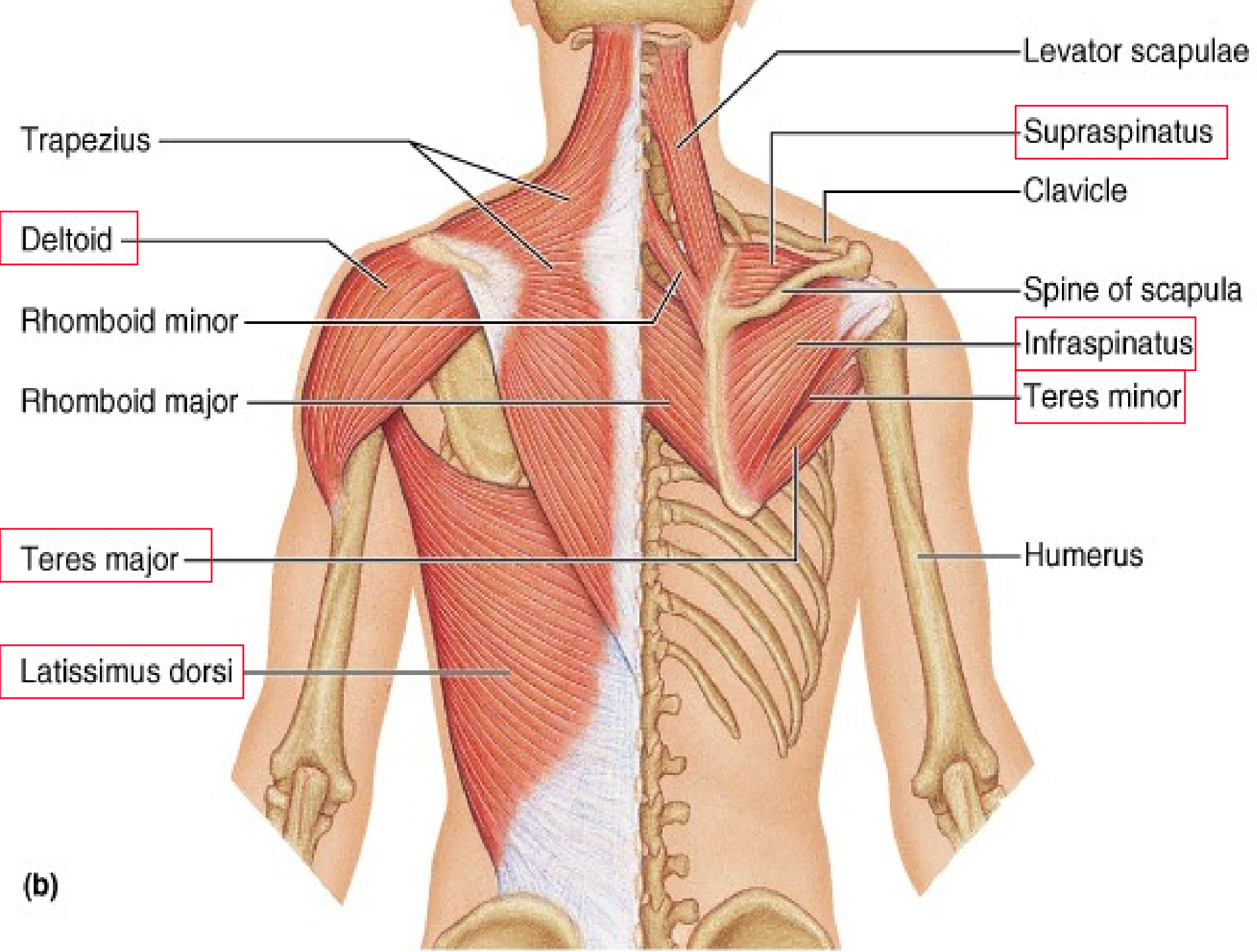
# Muscles Crossing the Shoulder Joint: Movement of the Arm

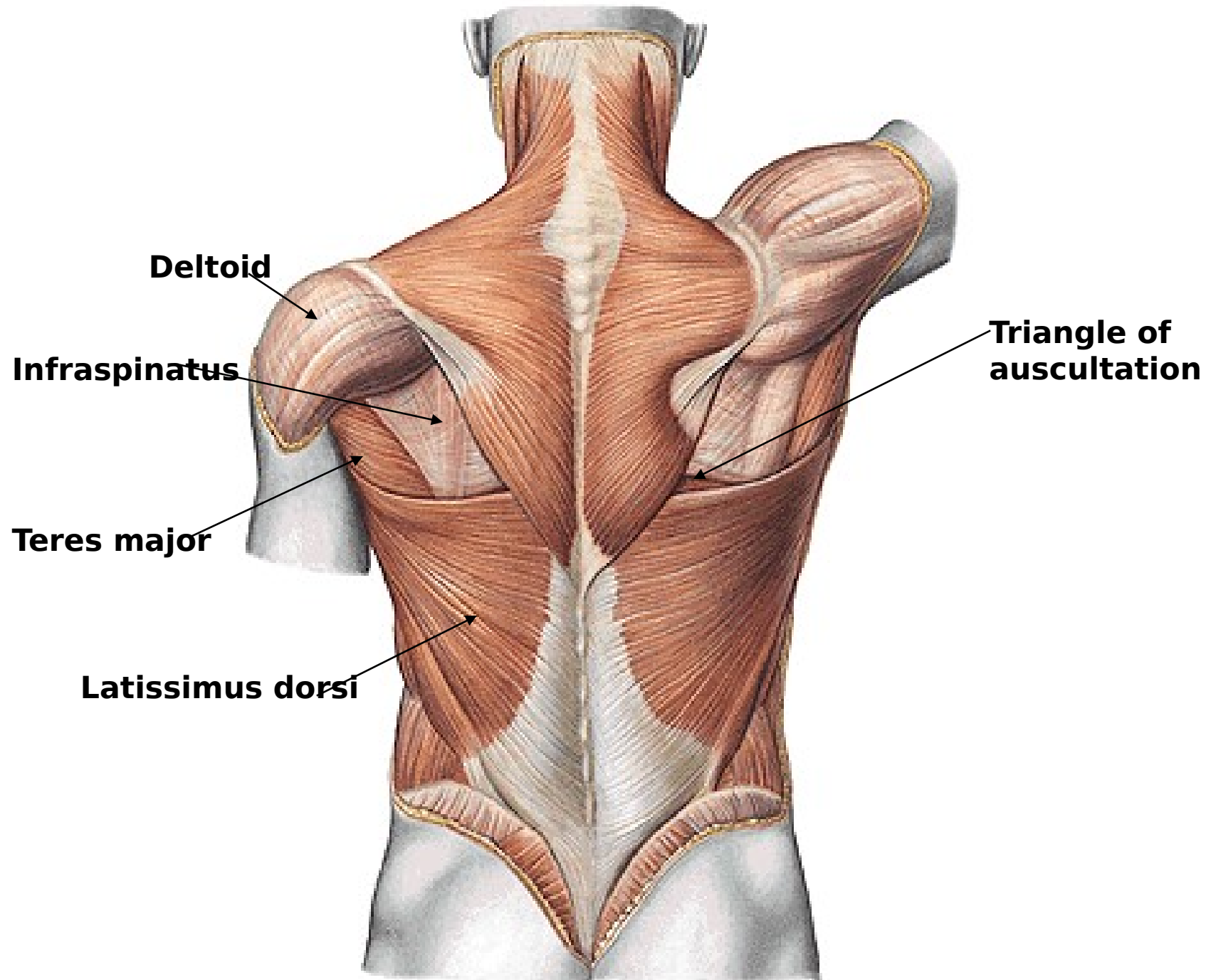
- A total of nine muscles cross each shoulder joint to insert on the humerus.
- All muscles acting on the humerus originate from the pectoral girdle; with **latissimus dorsi** & **pectoralis major** also originate on the axial skeleton

# **Muscles Crossing the Shoulder Joint**

- **Pectoralis major**
- **Latissimus dorsi**
- **Deltoid**
- **Subscapularis**
- **Supraspinatus**
- **Infraspinatus**
- **Teres minor & major**
- **Coracobrachialis**





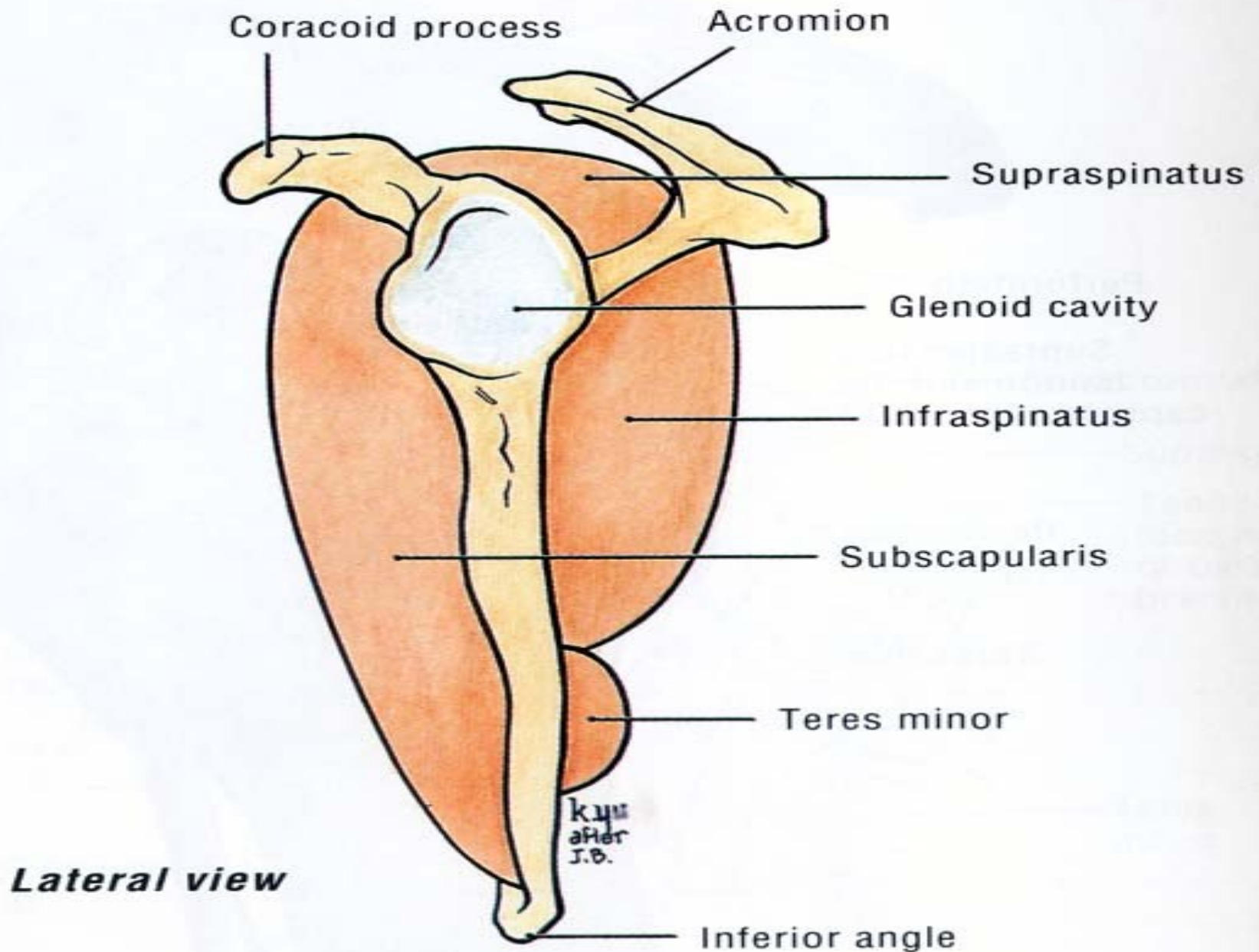


# Movement of the Arm

- Of these 9 muscles, only the superficial
  - **Pectoralis major,**
  - **Latissimus dorsi,** and
  - **Deltoid** musclesare prime movers of arm movement.
- The others are **synergists & fixators**

# **The Rotator Cuff Muscles**

- Four muscles makeup the rotator cuff muscles:
  - **Supraspinatus**
  - **Infraspinatus**
  - **Teres minor**
  - **Subscapularis**

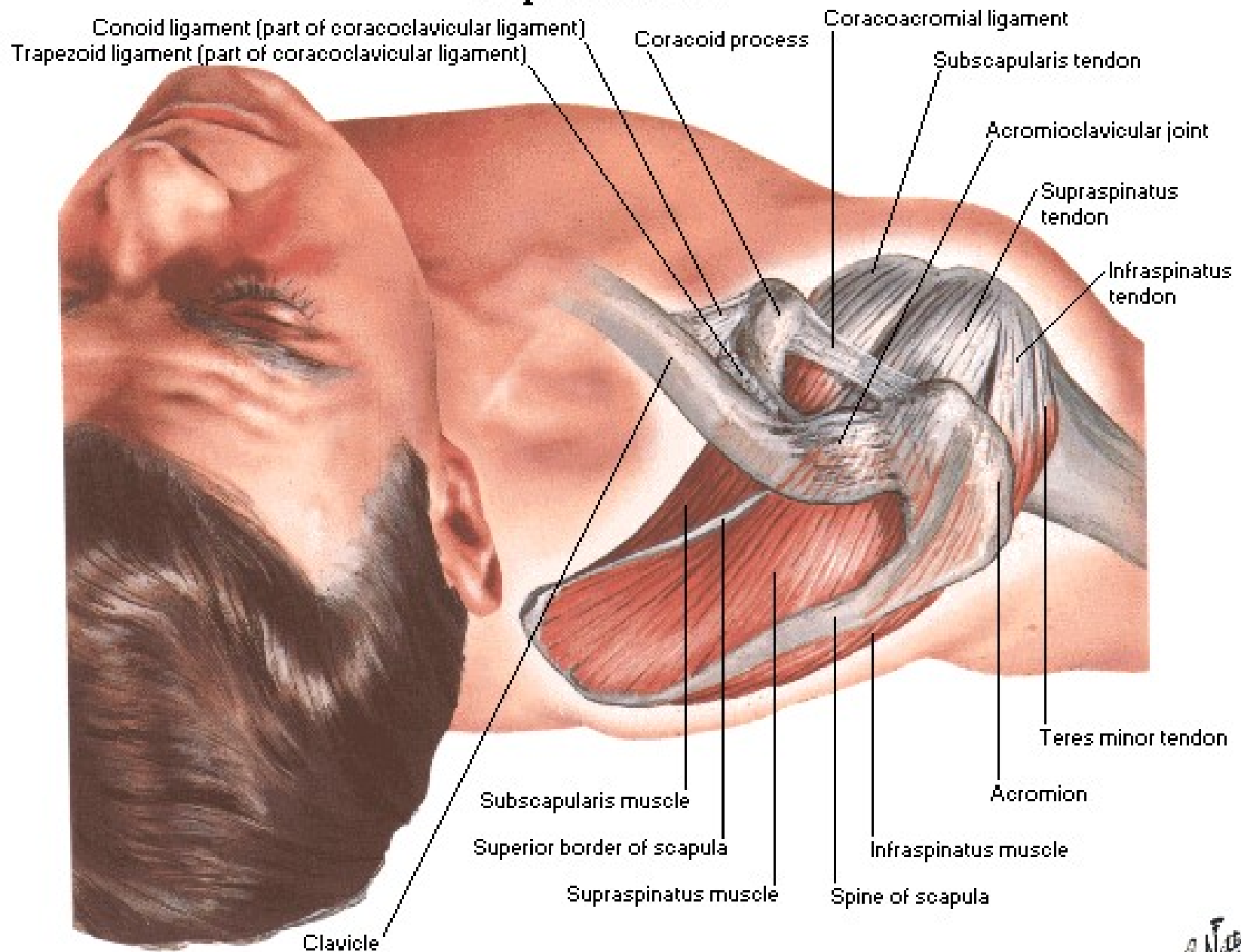


**6.51**

**Diagram of the rotator cuff**

# Muscles of Rotator Cuff

## Superior View

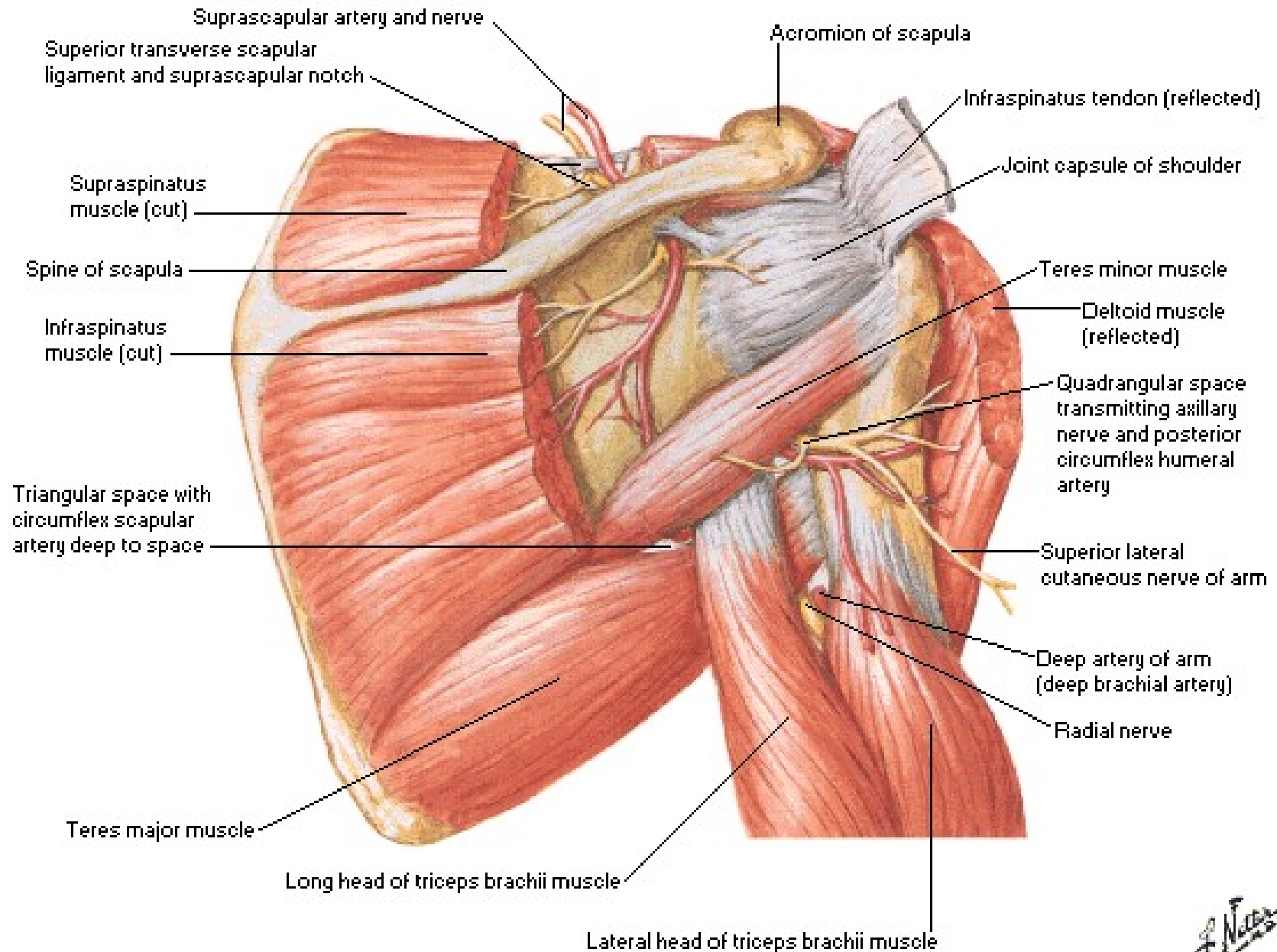


# **The Rotator Cuff Muscles**

- They originate on the scapula, and their tendons blend with the fibrous capsule of the shoulder joint.
- Their main function is to reinforce the capsule of the shoulder joint & prevent dislocation of the humerus.

# Scapulohumeral Dissection

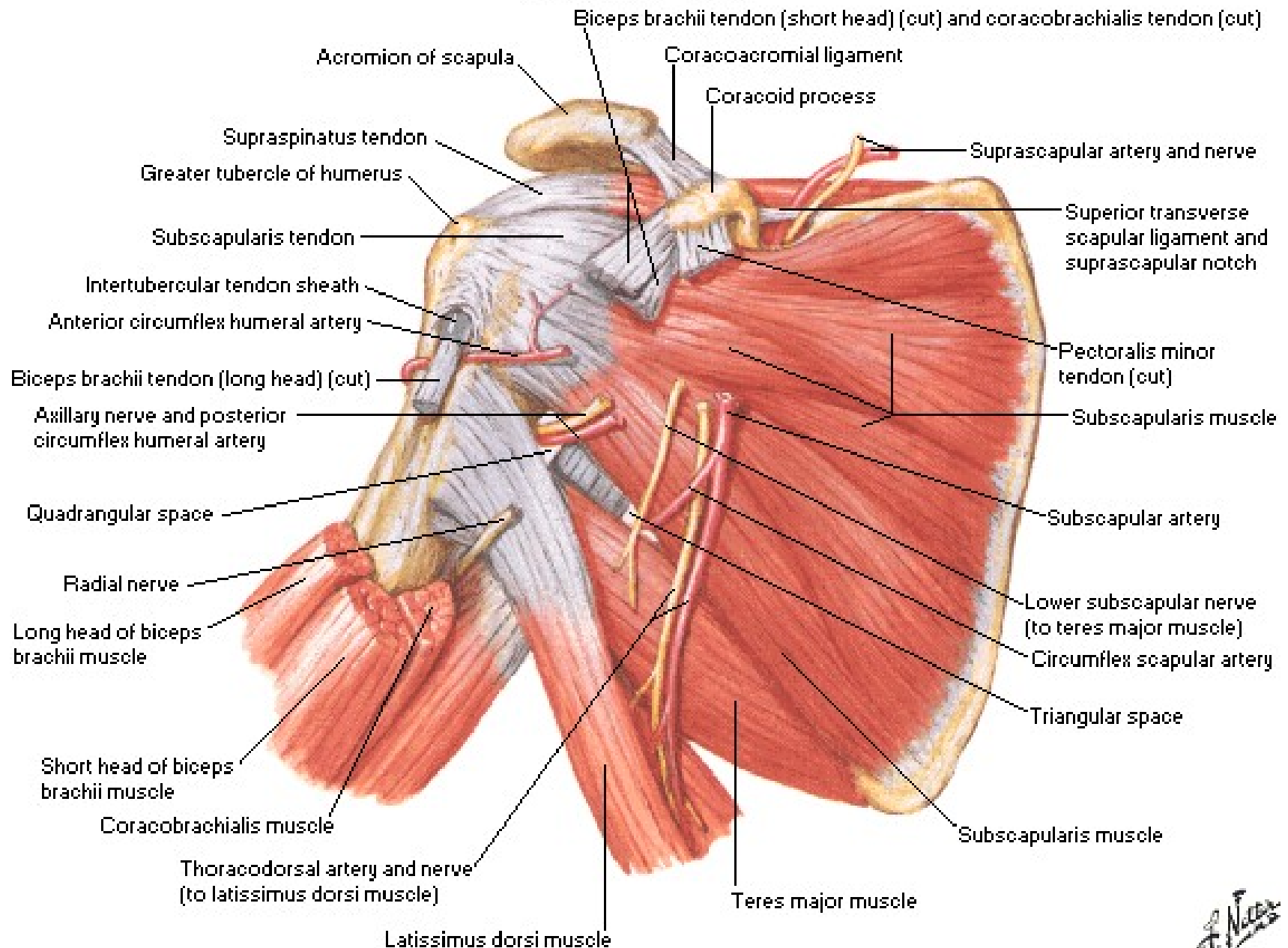
## Posterior View

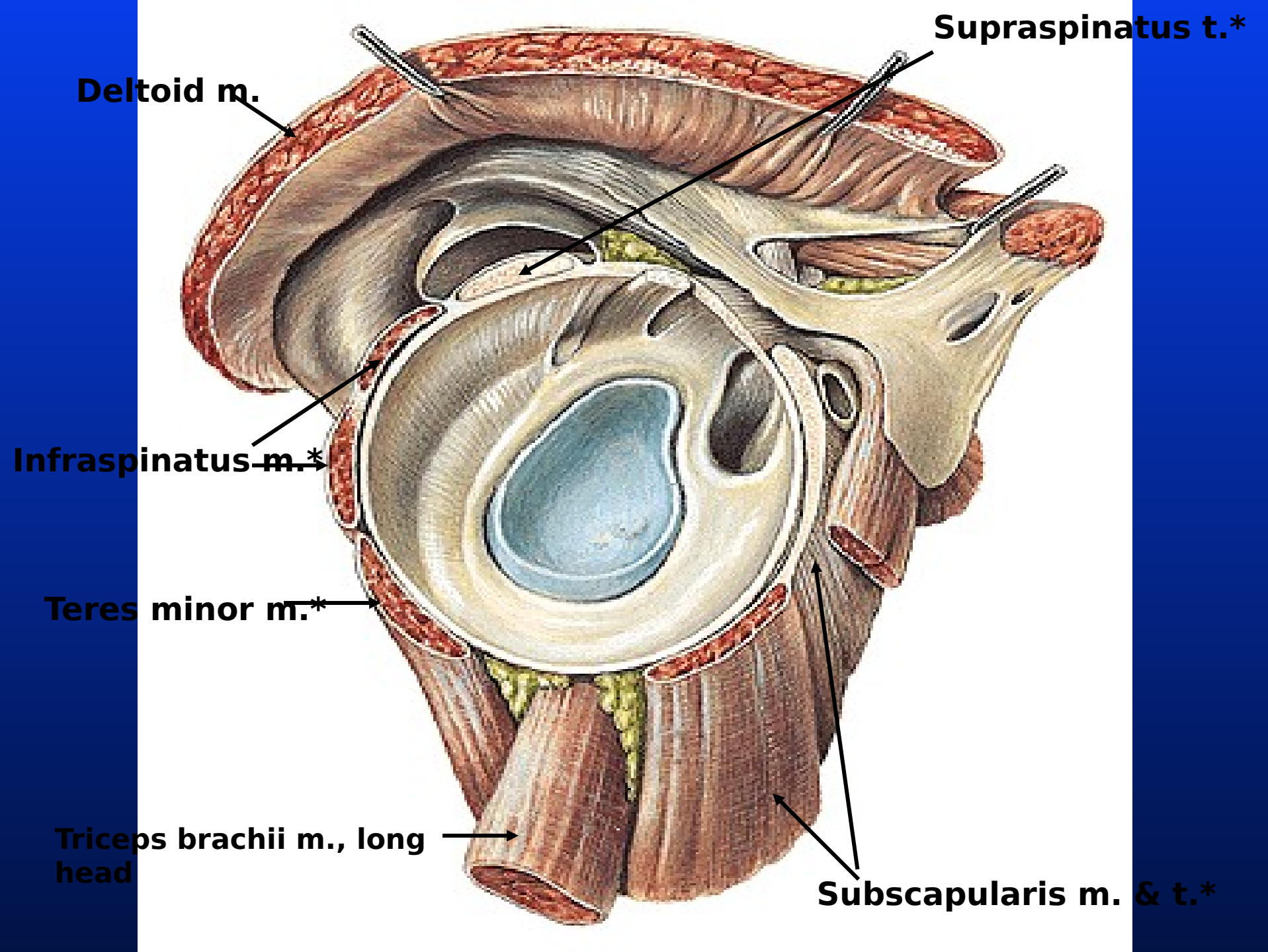




# Scapulohumeral Dissection

## Anterior View





Anterior Shoulder, Anterior

Subacromial bursa

Clavicle

Biceps brachii m., short head & Coracobrachialis m.

Subscapularis m.

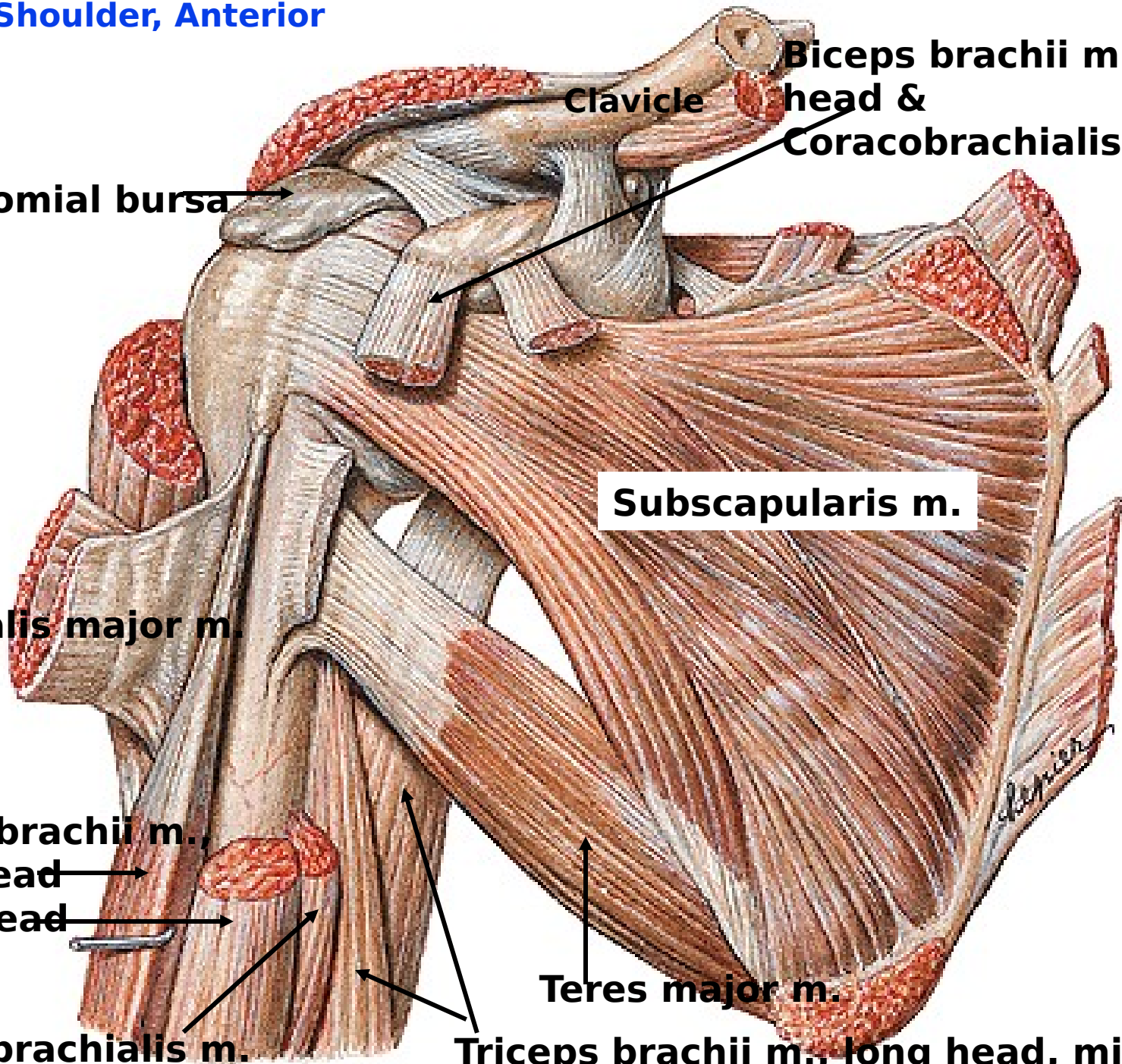
Pectoralis major m.

Biceps brachii m., long head  
short head

Coracobrachialis m.

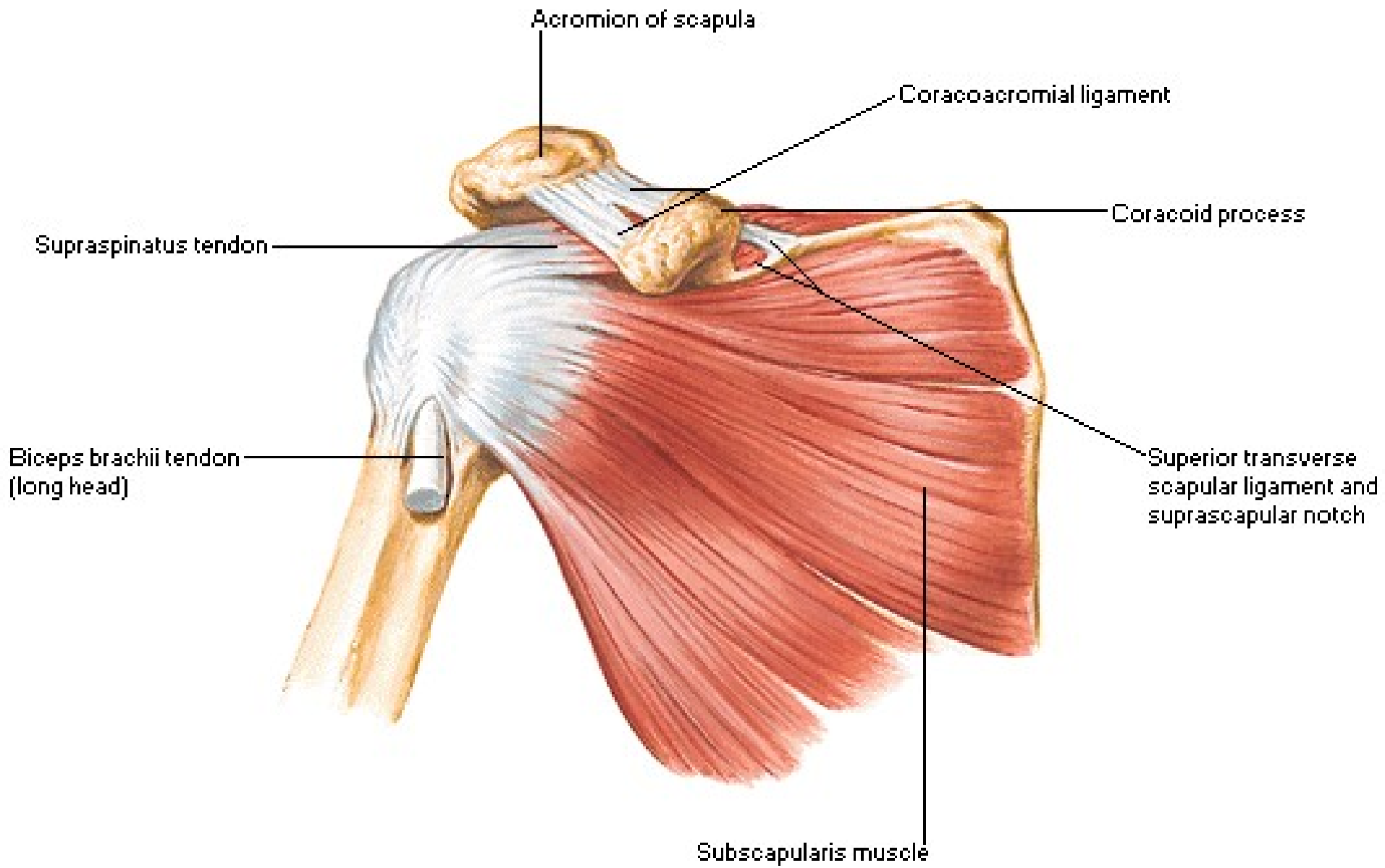
Teres major m.

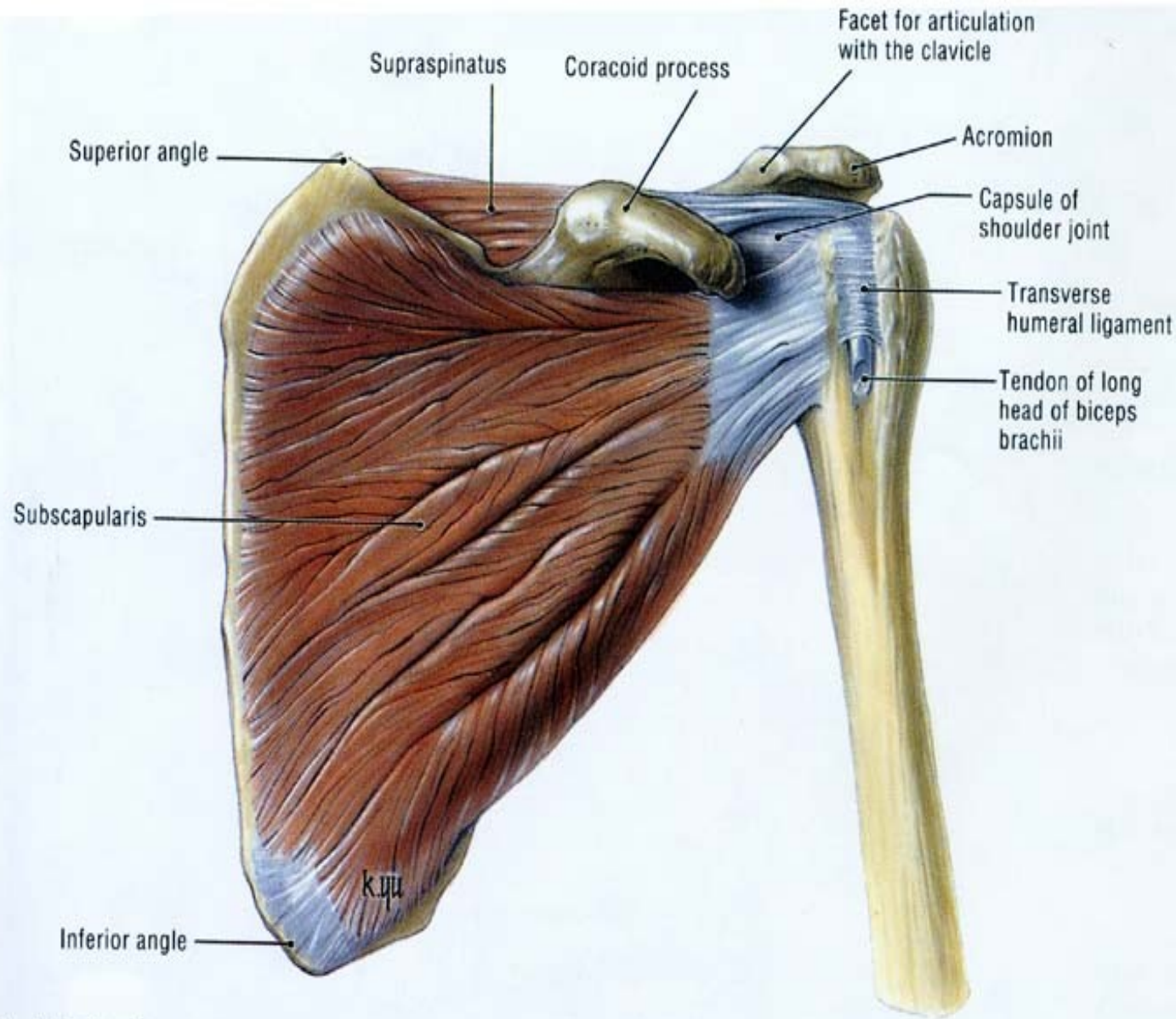
Triceps brachii m., long head, middle head



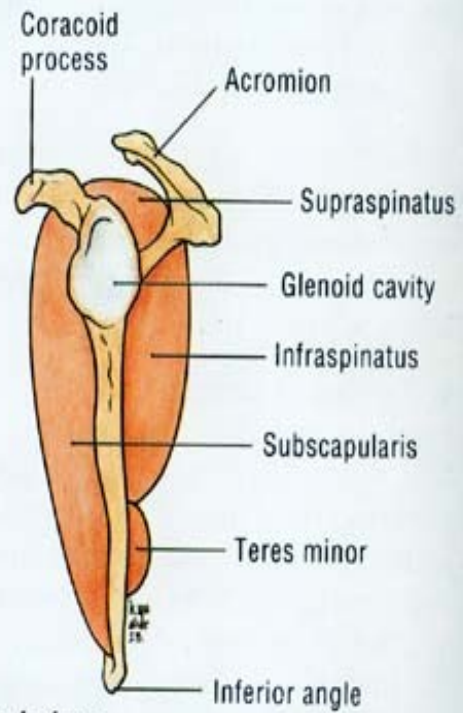
# Muscles of Rotator Cuff

## Anterior View





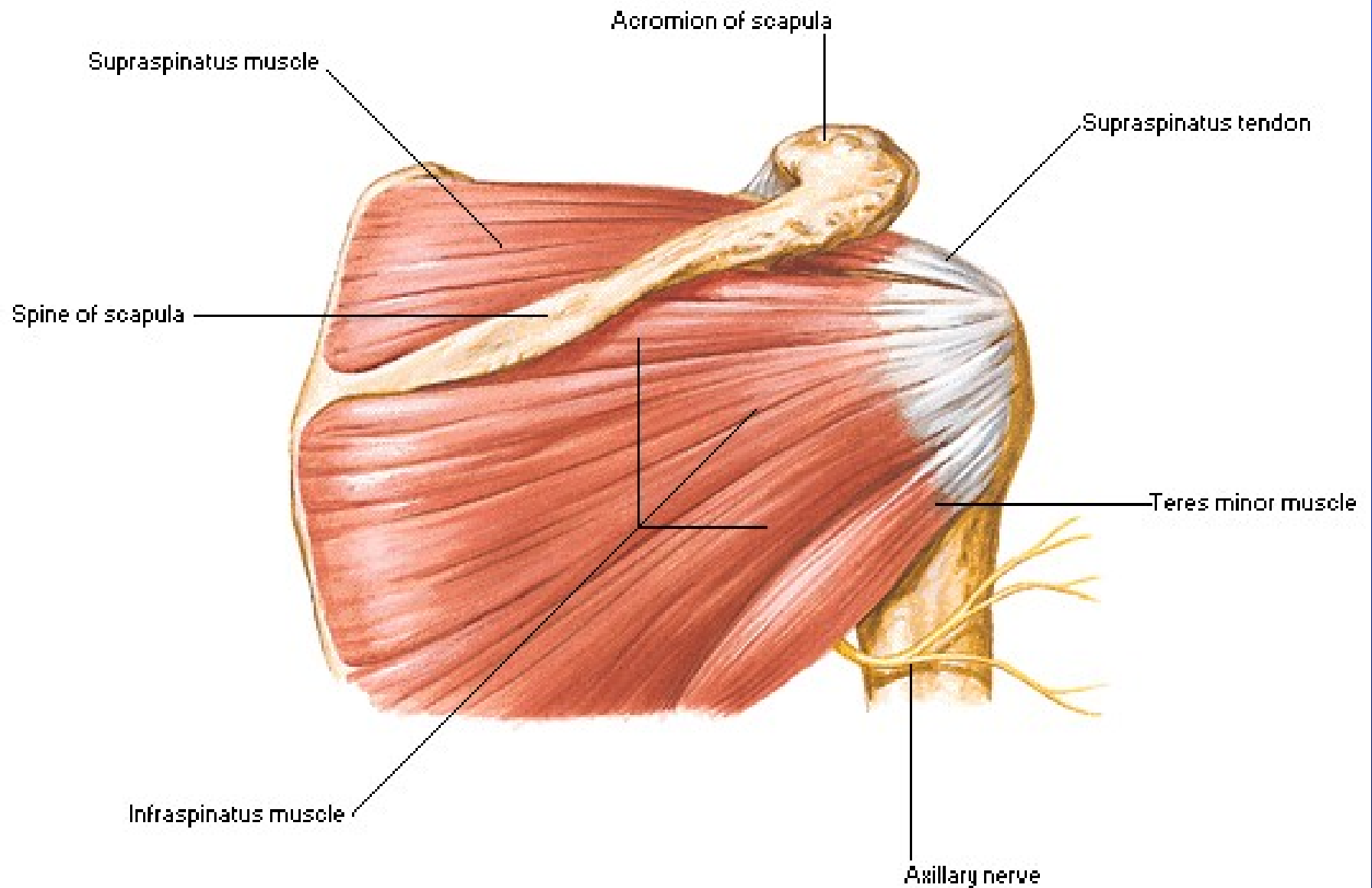
**B, Anterior view**



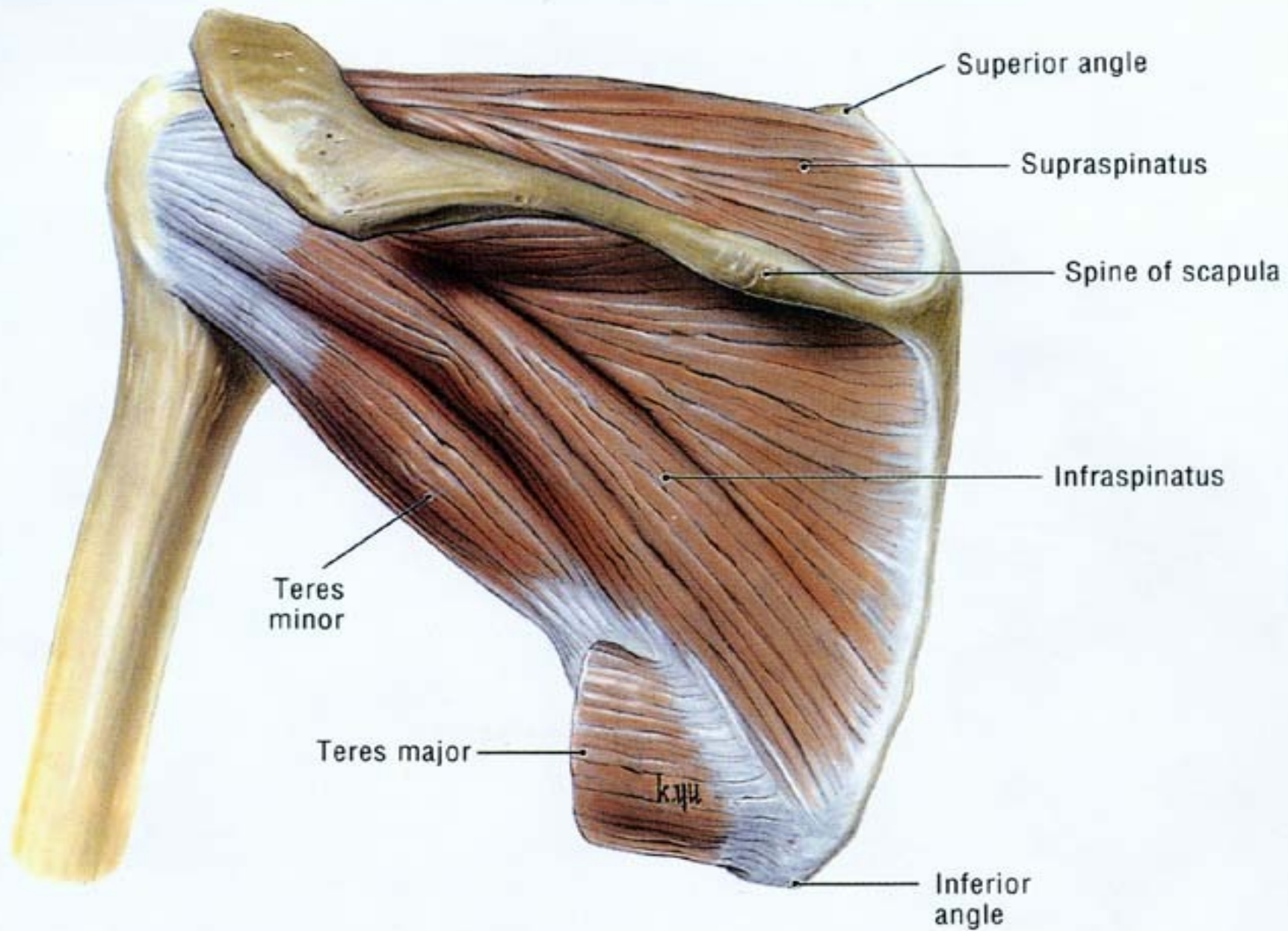
**C, Lateral view**

# Muscles of Rotator Cuff

## Posterior View







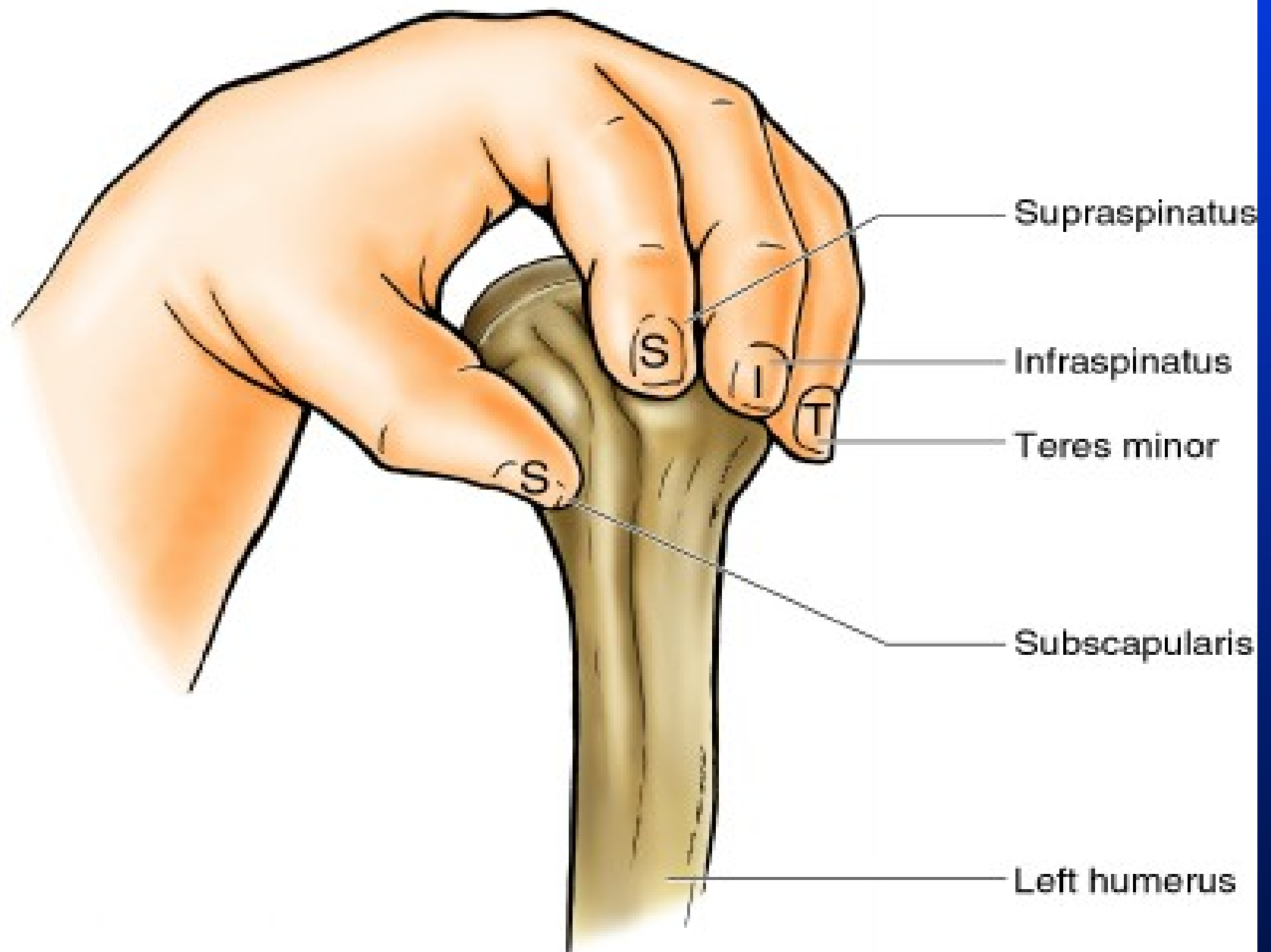
**A, Posterior view**

# **MUSCLES OF THE ROTATOR CUFF**

- Rotator cuff (page 697-689, Moore)
  - **Supraspinatus**
  - **Infraspinatus**
  - **Teres minor**
  - **Subscapularis**



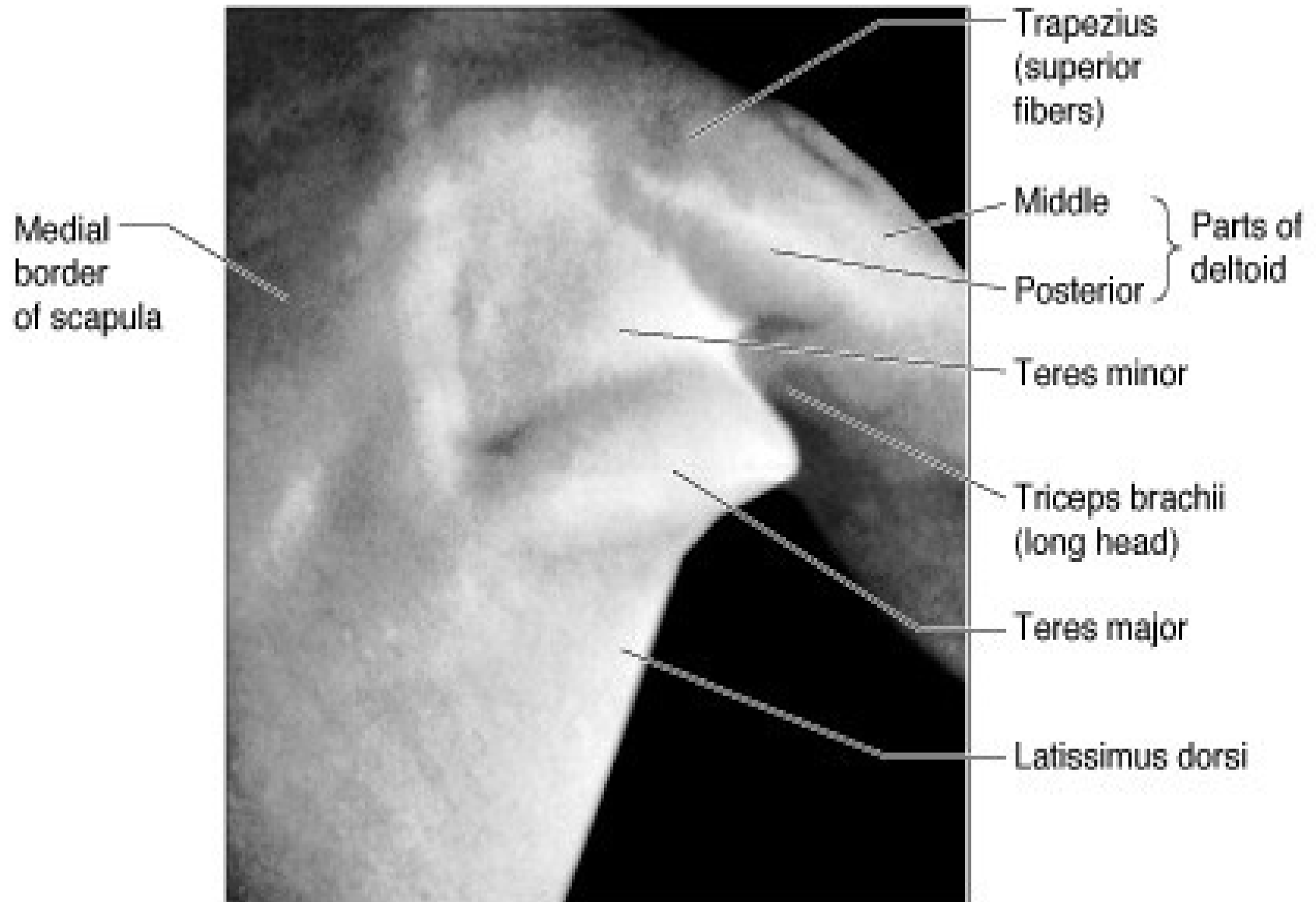
6.22. Demonstration of the position of the rotator cuff muscles.



# SCAPULAR MUSCLES

- All have origin on the scapula
  - **Deltoid**
  - **Supraspinatus**
  - **Infraspinatus**
  - **Teres minor**
  - **Teres major**
  - **Subscapularis**

## 6.21A, B. Scapulohumeral muscles.



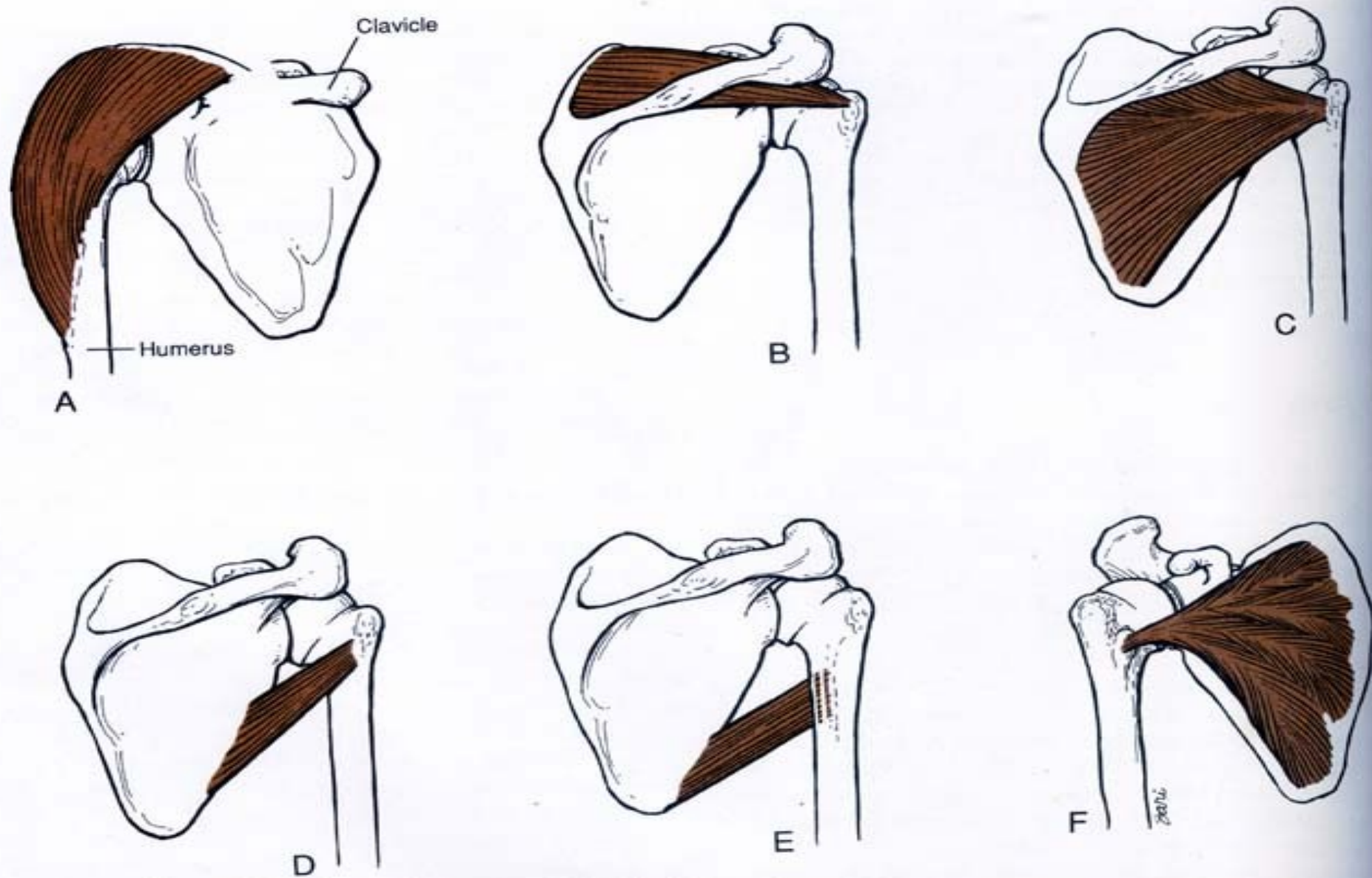


Humeral head  
in glenoid cavity

Medial lip of  
intertubercular  
groove of  
humerus

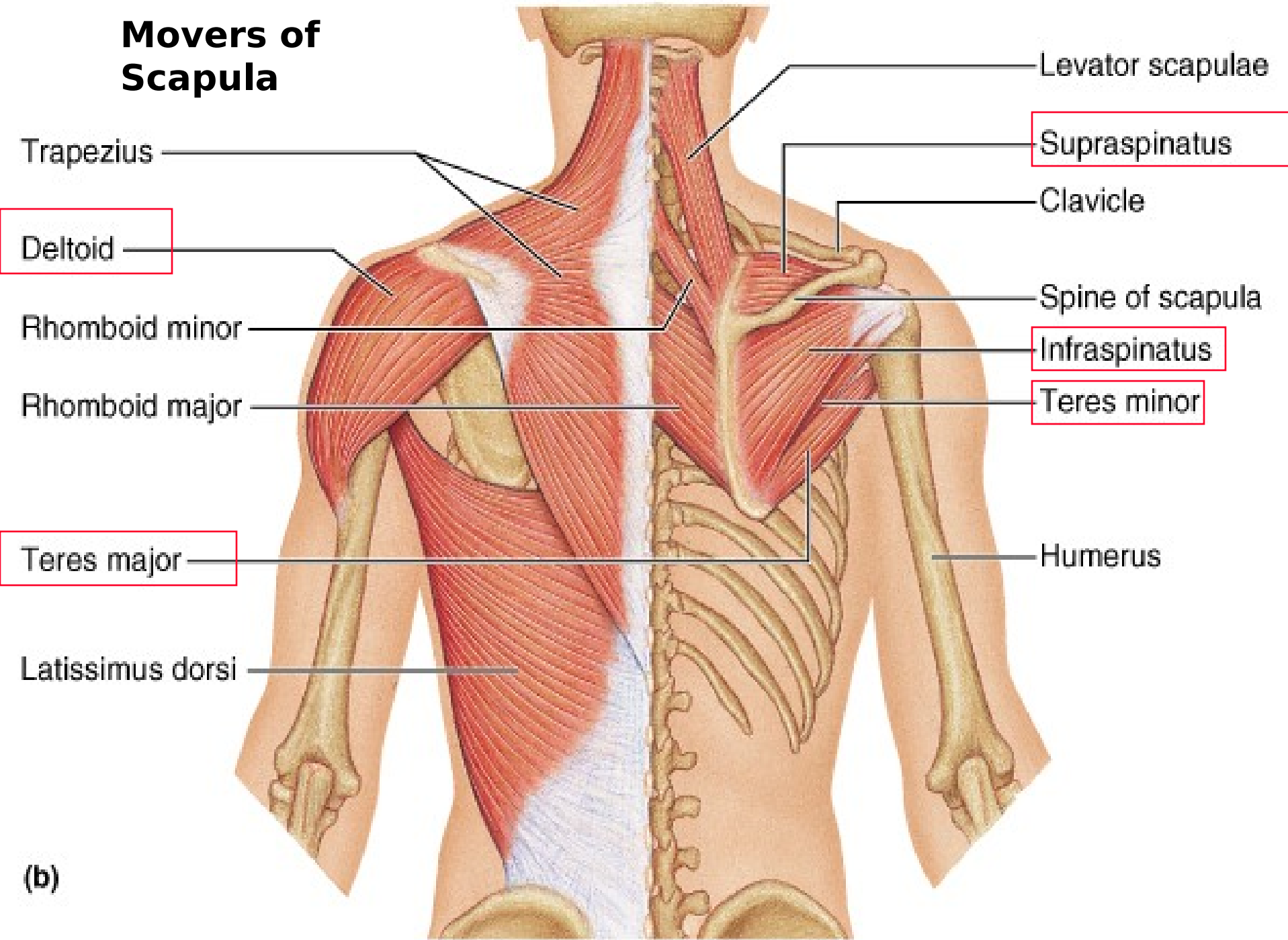
Teres major

Posterior  
axillary fold

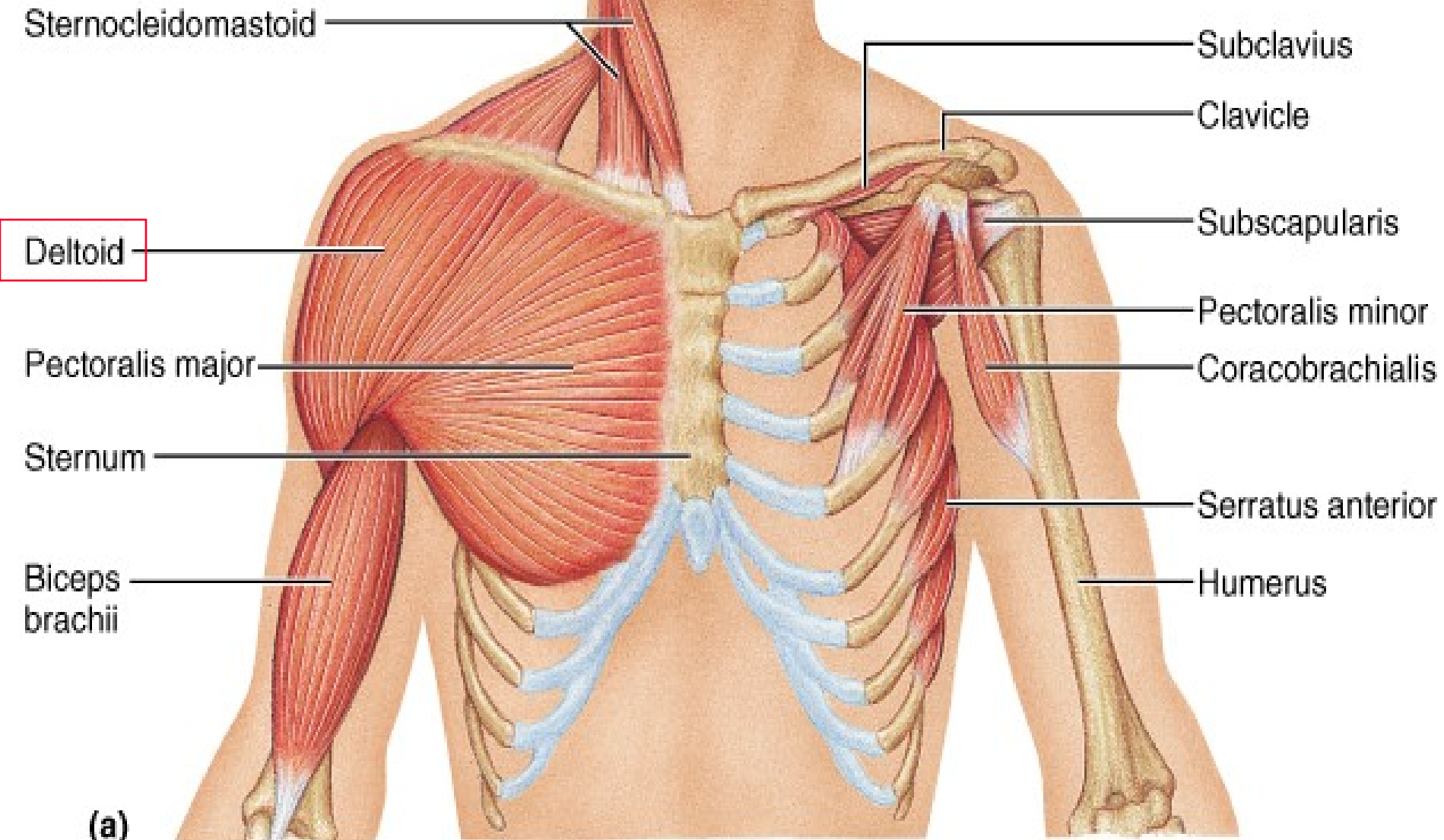


**Figure 6-44.** The scapular muscles. *A*, Deltoid. *B*, Supraspinatus. *C*, Infraspinatus. *D*, Teres minor. *E*, Teres major. *F*, Subscapularis.

## Movers of Scapula



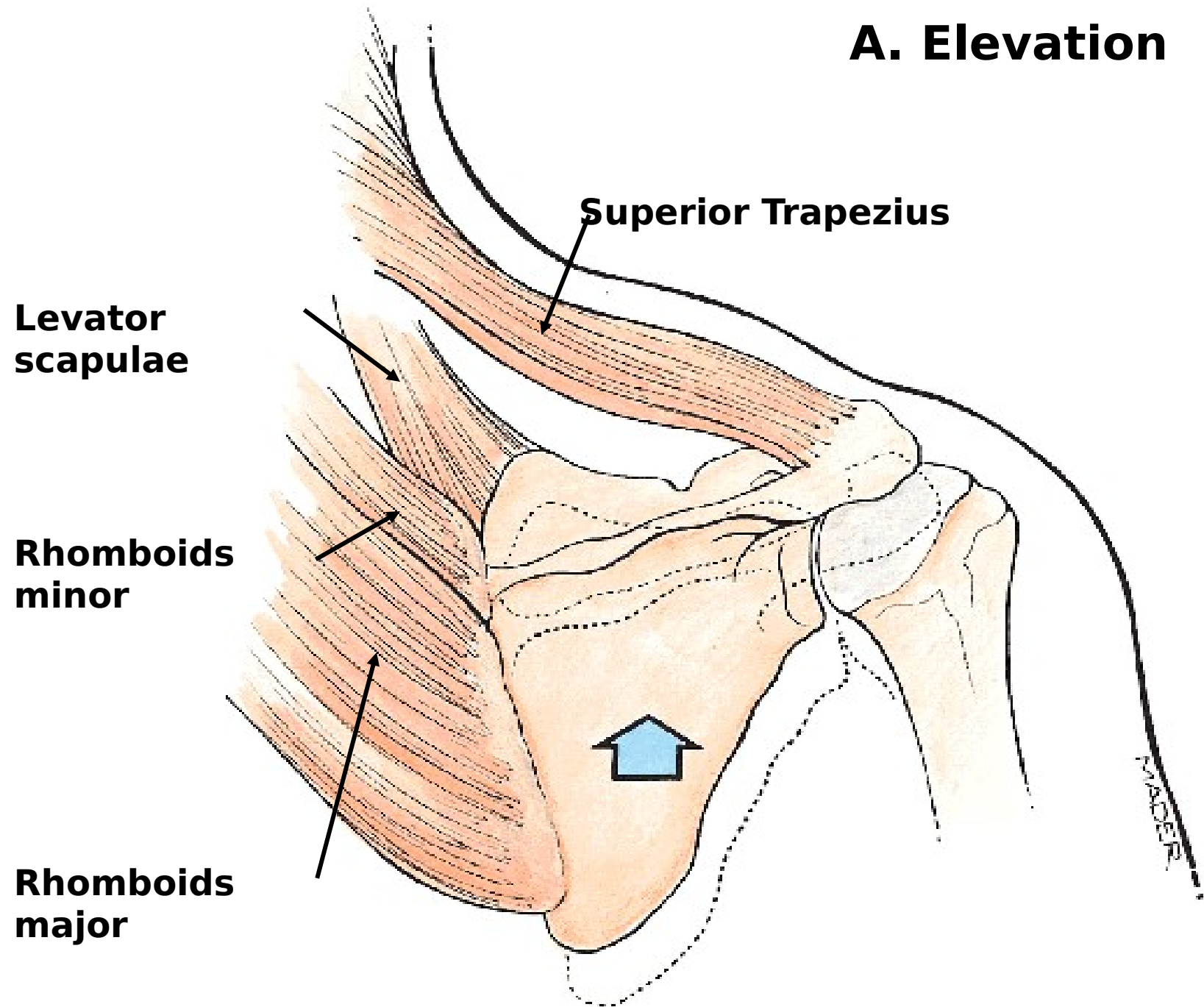
## Movers of Scapula



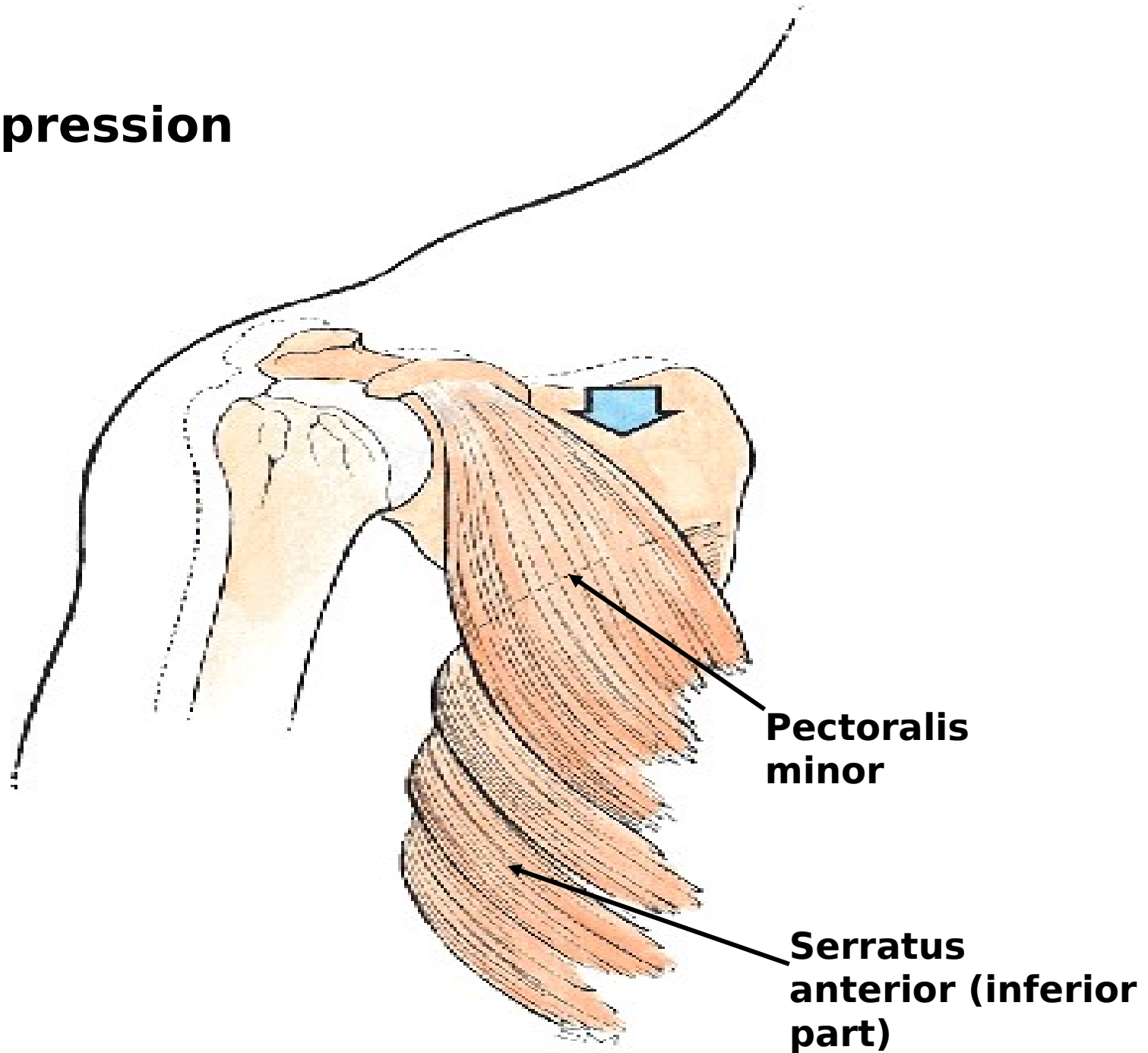
# **Movements of the Posterior Thoracoappendicul ar and Scapulohumeral Muscles**



## A. Elevation

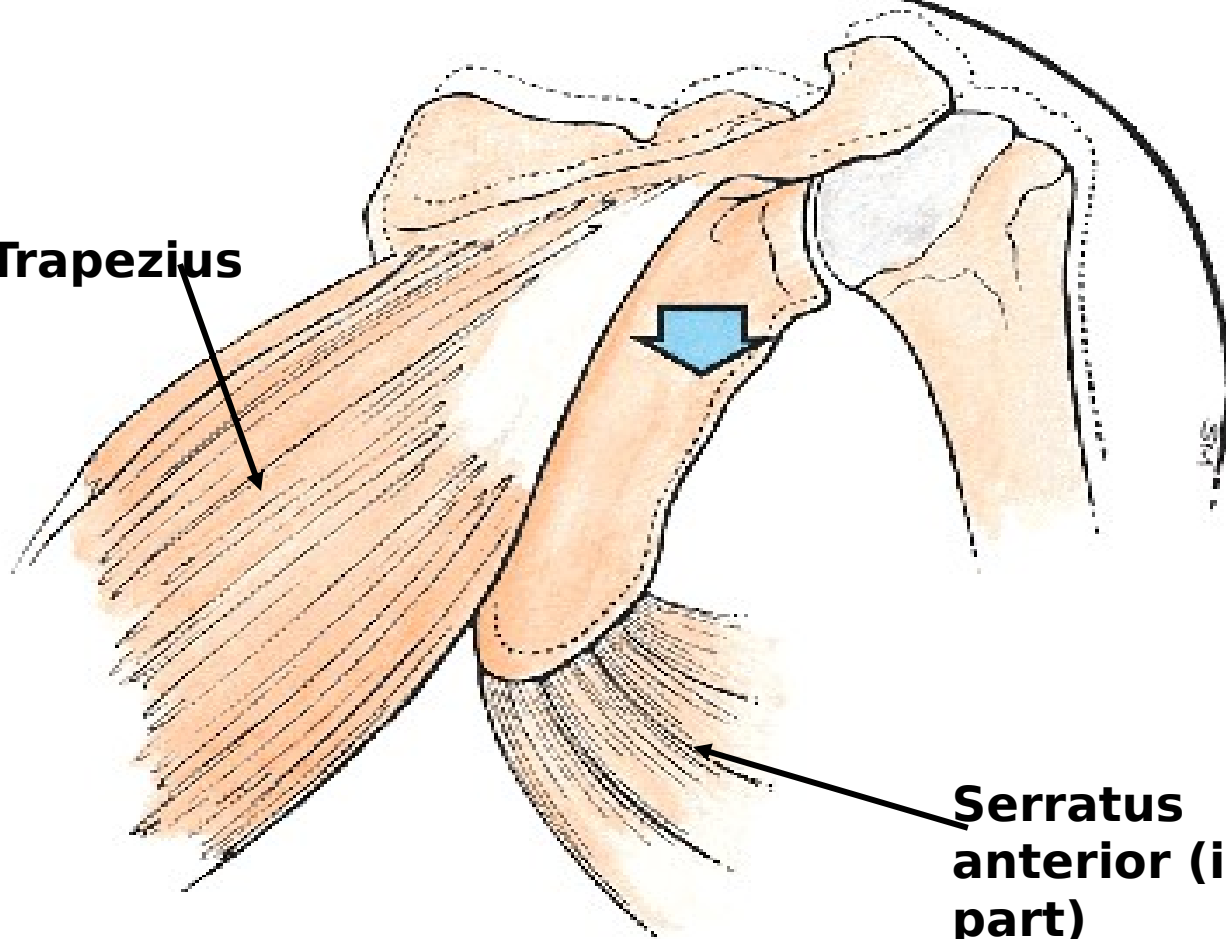


## **B. Depression**



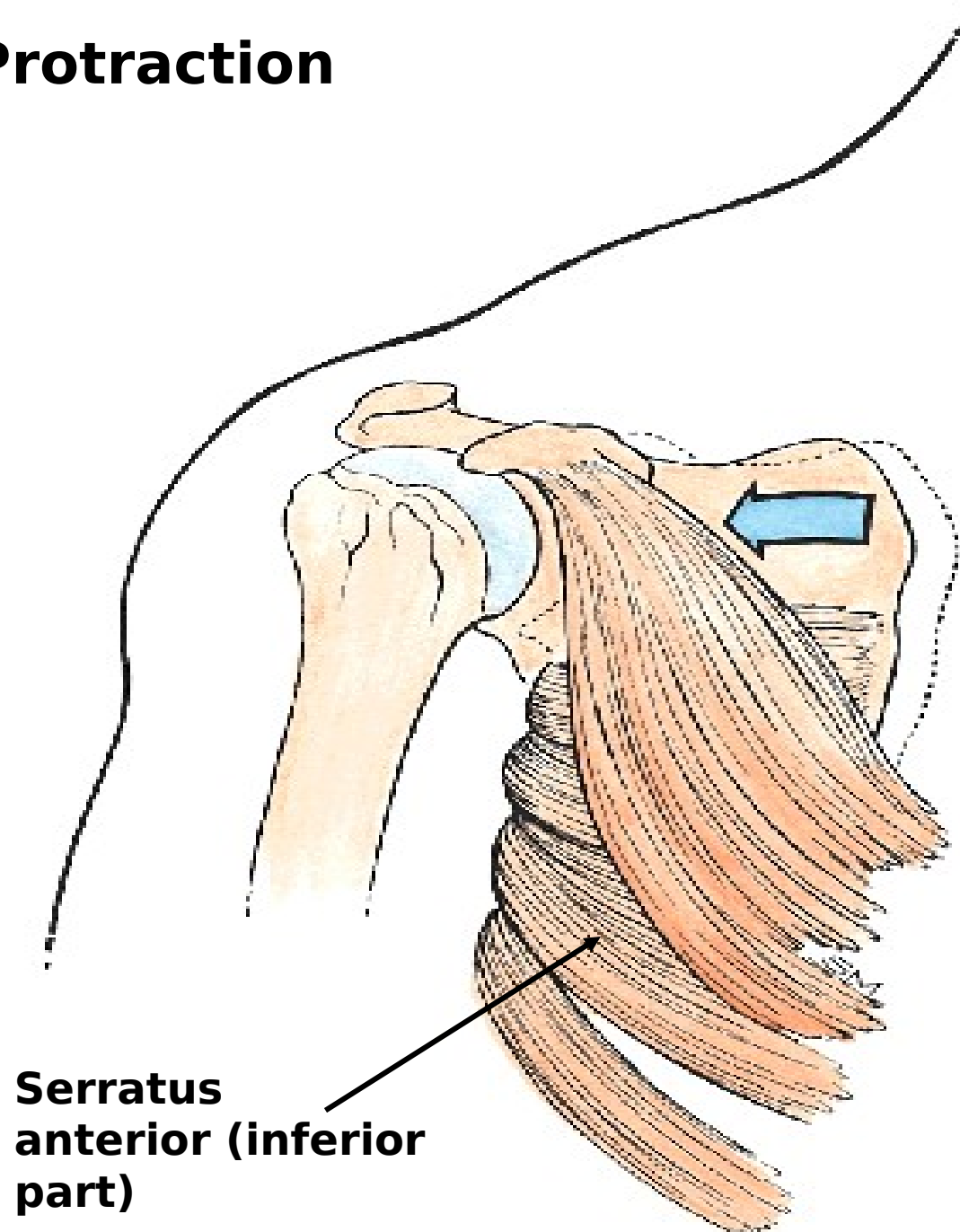
## B. Depression

Inferior Trapezius



Serratus  
anterior (inferior  
part)

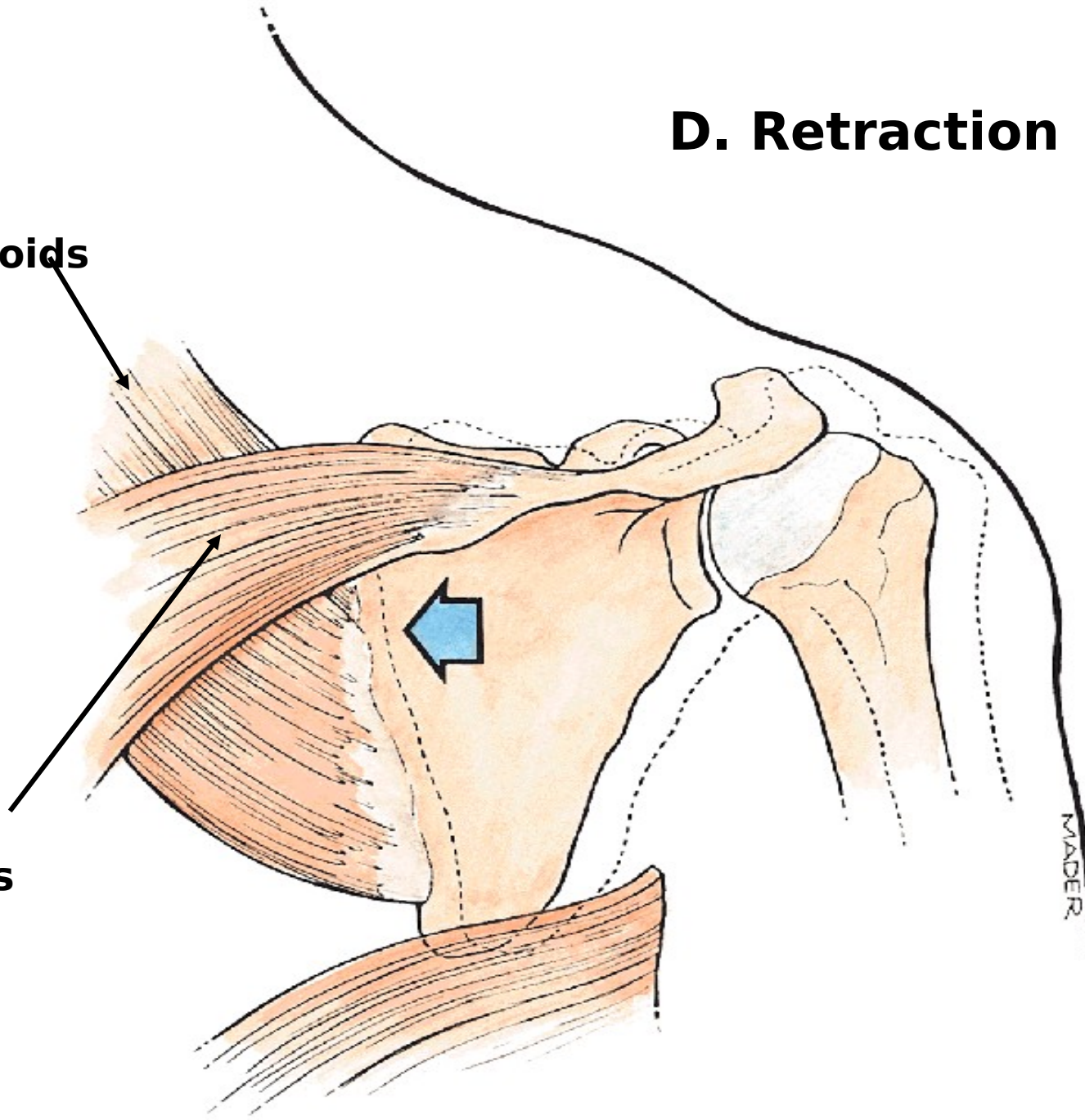
## C. Protraction



## D. Retraction

**Rhomboids**

**Middle  
Trapezius**

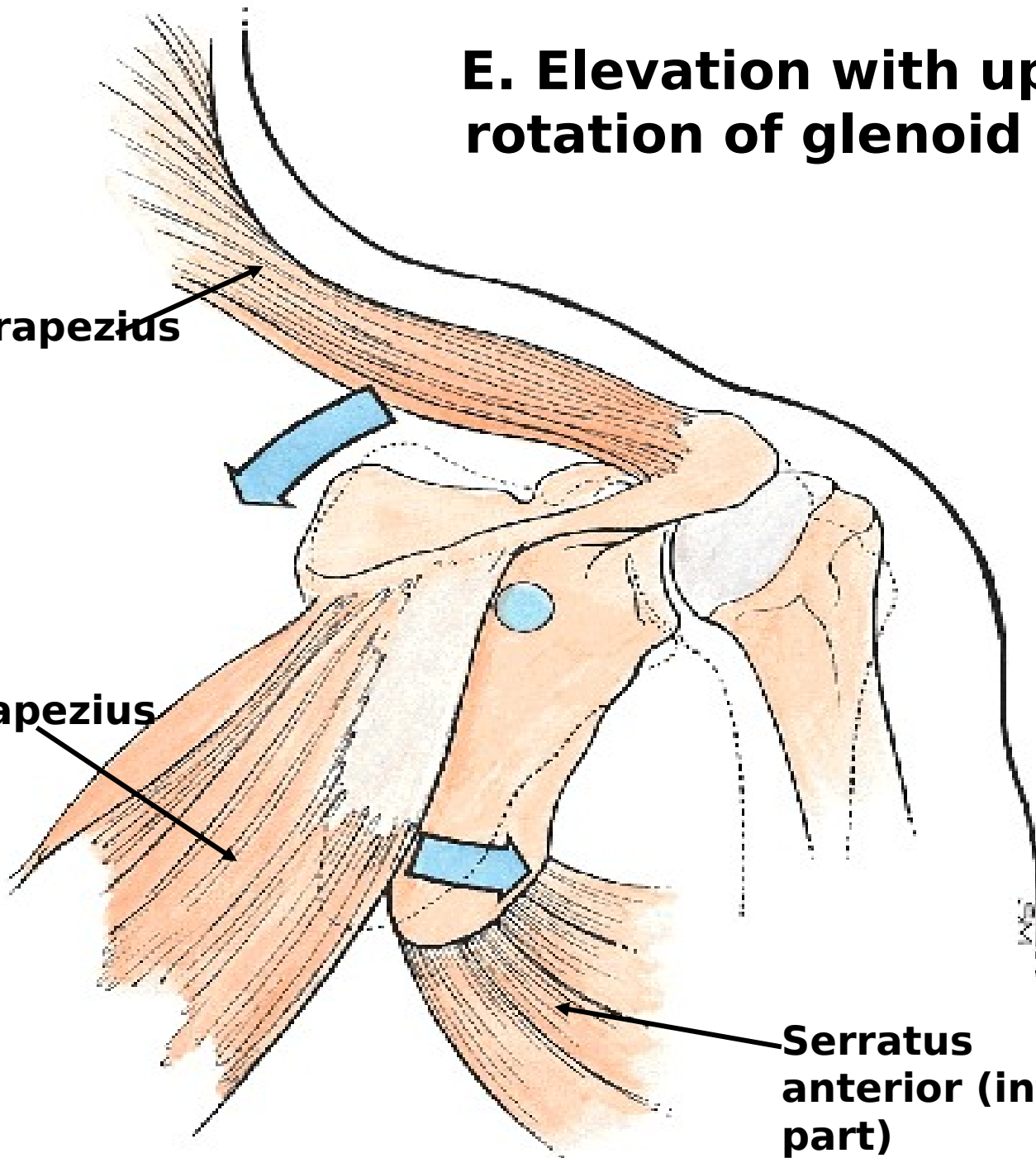


## E. Elevation with upward rotation of glenoid fossa

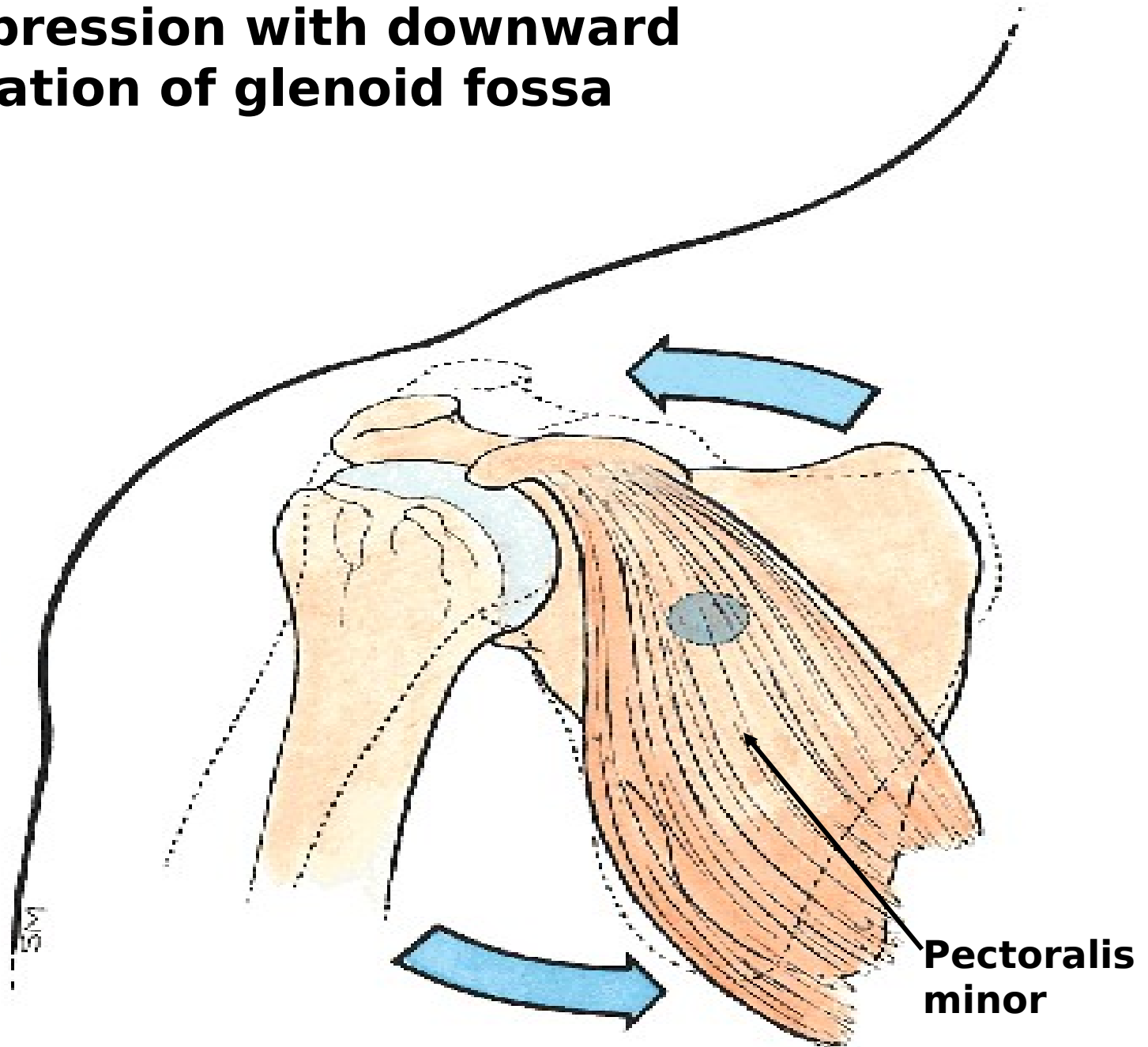
**Superior Trapezius**

**Inferior Trapezius**

**Serratus  
anterior (inferior  
part)**



## F. Depression with downward rotation of glenoid fossa

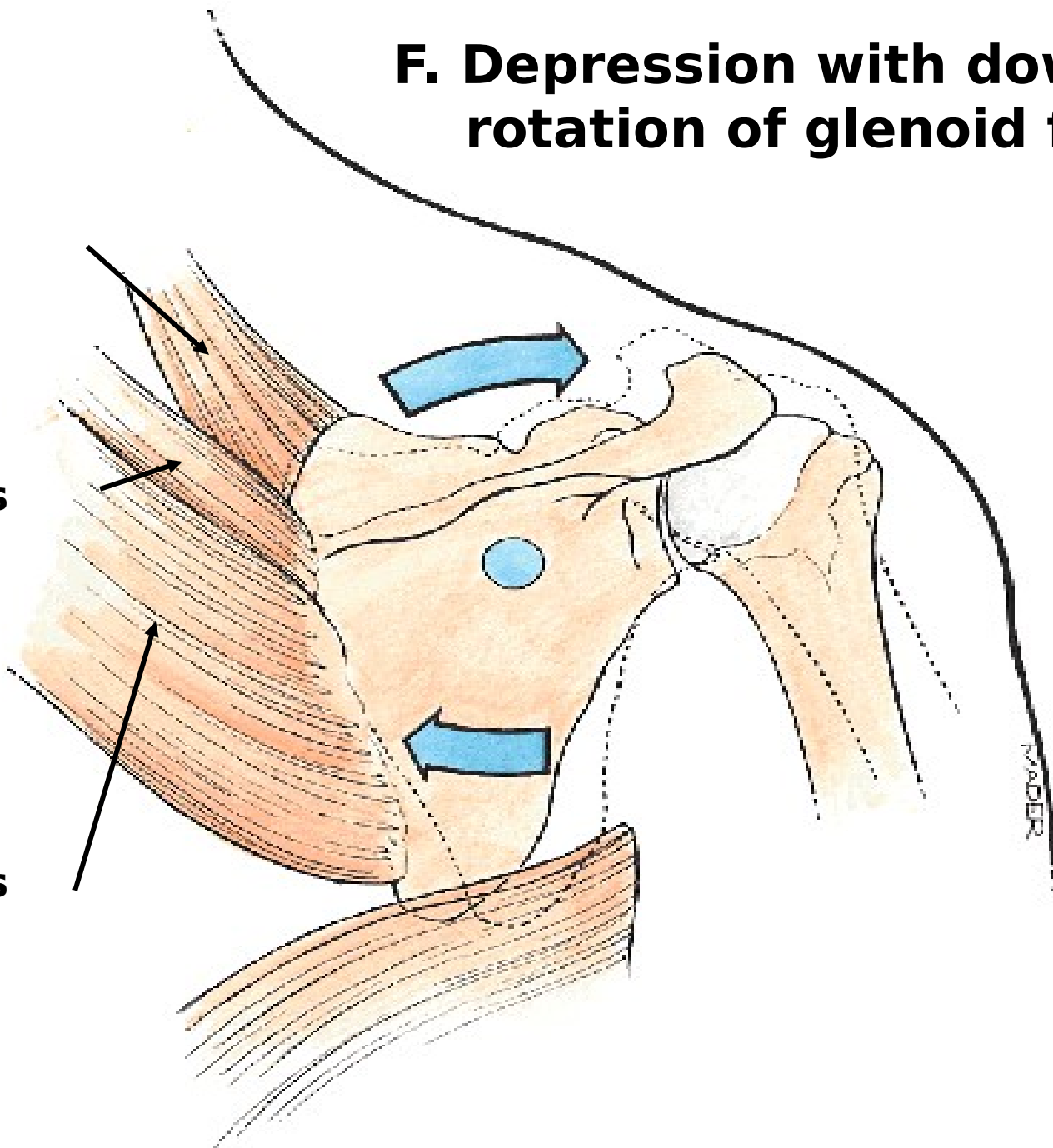


## F. Depression with downward rotation of glenoid fossa

**Levator  
scapulae**

**Rhomboids  
minor**

**Rhomboids  
major**





# QUESTIONS?



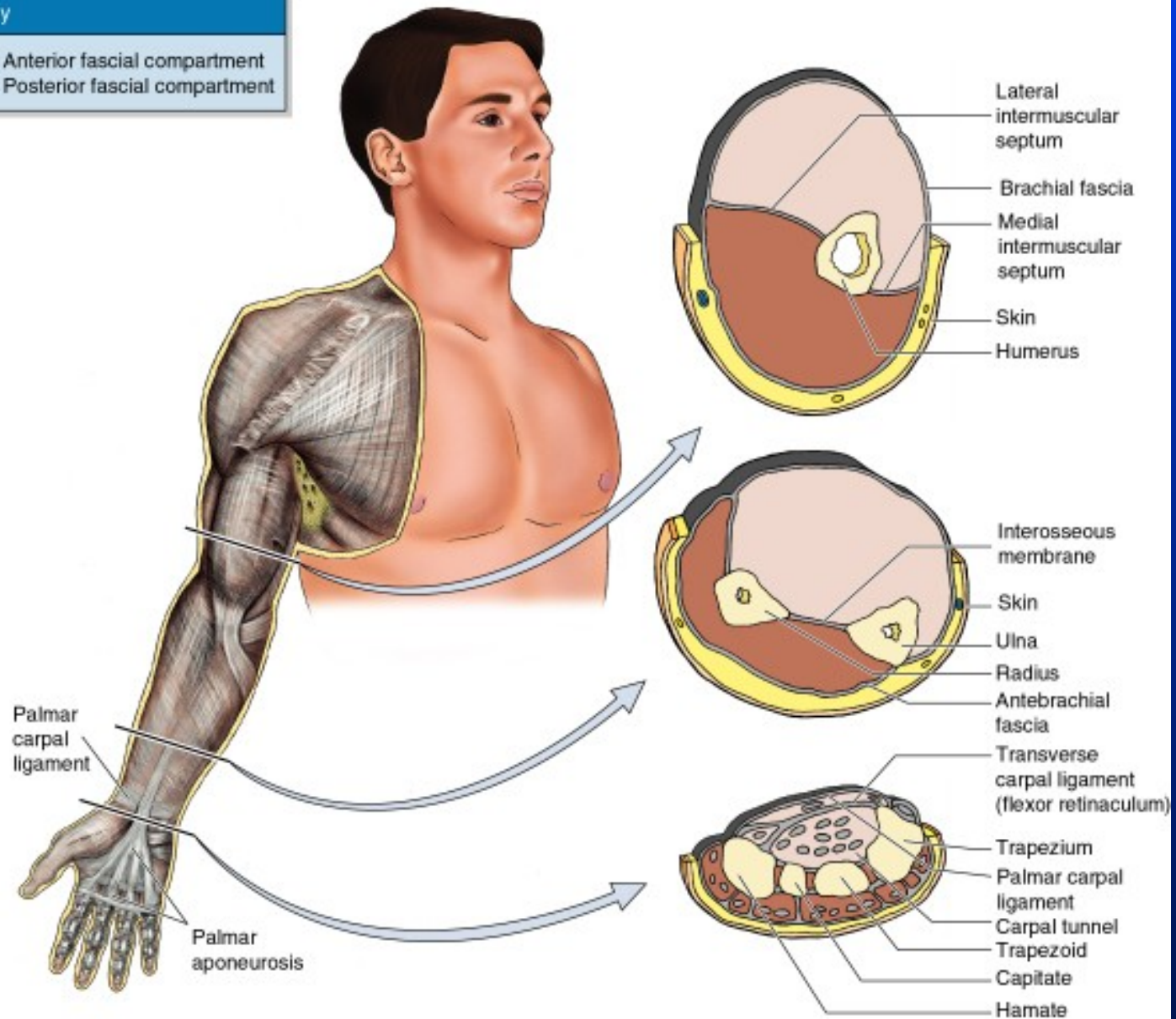
# **THE ARM**

Anatomy & Physiology I

## 6.10. Fascia of the upper limb.

### Key

- Anterior fascial compartment
- Posterior fascial compartment



# MOVEMENT OF THE ARM

- The two remaining muscles:

- **Teres major**

- **Coracobrachialis**

crosses the shoulder joint but  
insert on to the humerus to  
move the upper arm.

# Coracobrachialis

**S**

- O** = Tip of coracoid process of scapula
- I** = Middle third of medial surface of humerus
- F** = Helps to flex and adduct arm



**Table 6.5. Muscles of the Arm**

Biceps brachii  
(short head) and  
coracobrachialis

Pectoralis  
minor

Coraco-  
brachialis

Brachialis

Brachialis

Biceps  
brachii

Undersurface  
of acromion  
process

Supraglenoid  
tubercle

Coracoid  
process

Transverse  
humeral  
ligament

Inter-  
tubercular  
groove

Tendon of  
short head

Tendon of  
long head

Radial  
tuberosity

Bicipital  
aponeurosis

Clavicle

Scapula

Body of  
humerus

(Anterior views)

**Biceps brachii**

**Brachialis**

**Coracobrachialis**

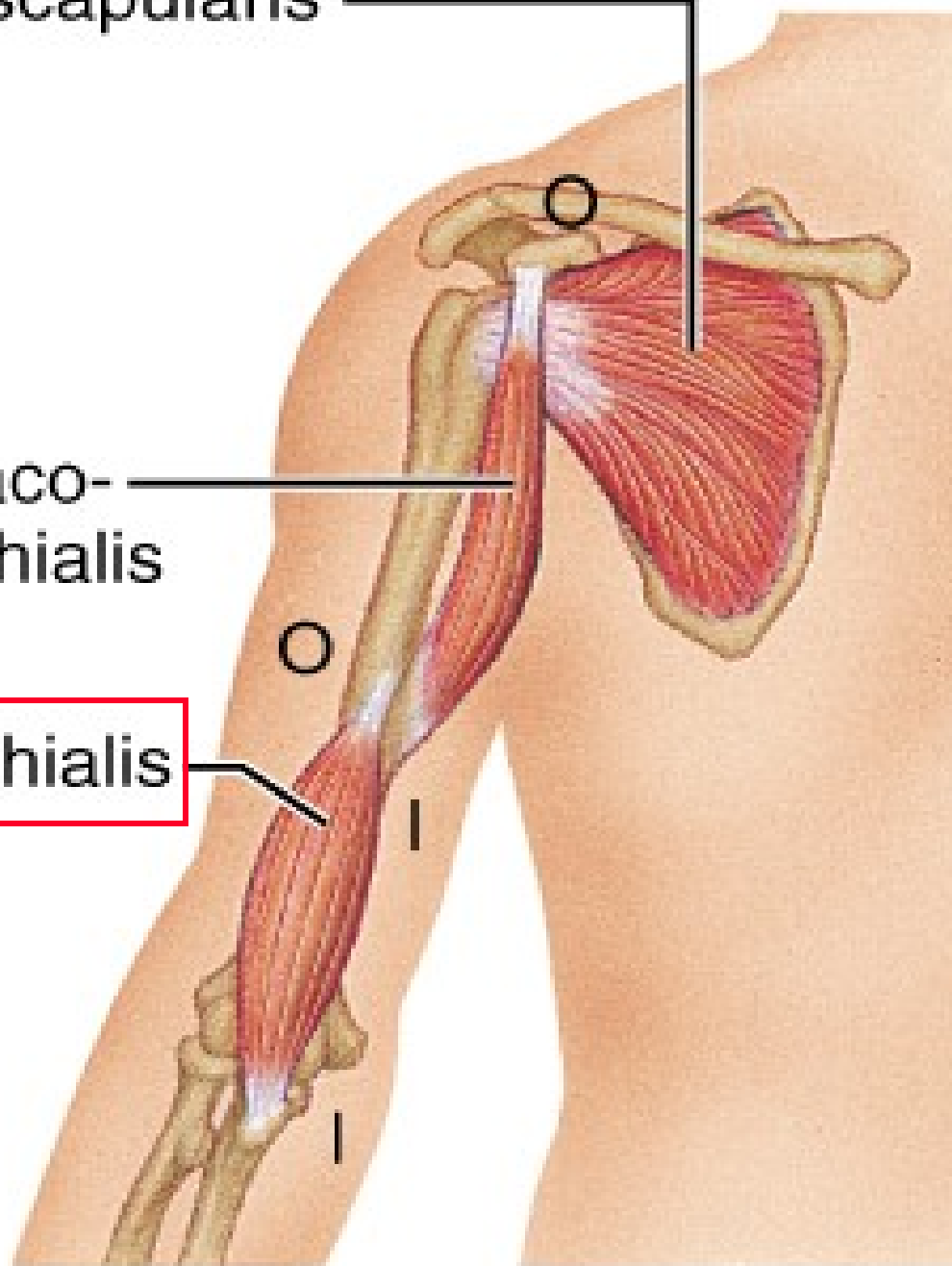
Muscle	Proximal Attachment	Distal Attachment	Innervation <sup>a</sup>	Main Action
Biceps brachii	Short head: tip of coracoid process of scapula Long head: supraglenoid tubercle of scapula	Tuberosity of radius and fascia of forearm via bicipital aponeurosis	Musculocutaneous nerve <sup>b</sup> (C5 and C6)	Supinates forearm and, when it is supine, flexes forearm
Brachialis	Distal half of anterior surface of humerus	Coronoid process and tuberosity of ulna		Flexes forearm in all positions
Coracobrachialis	Tip of coracoid process of scapula	Middle third of medial surface of humerus	Musculocutaneous nerve (C5, C6, and C7)	Helps to flex and adduct arm

Subscapularis

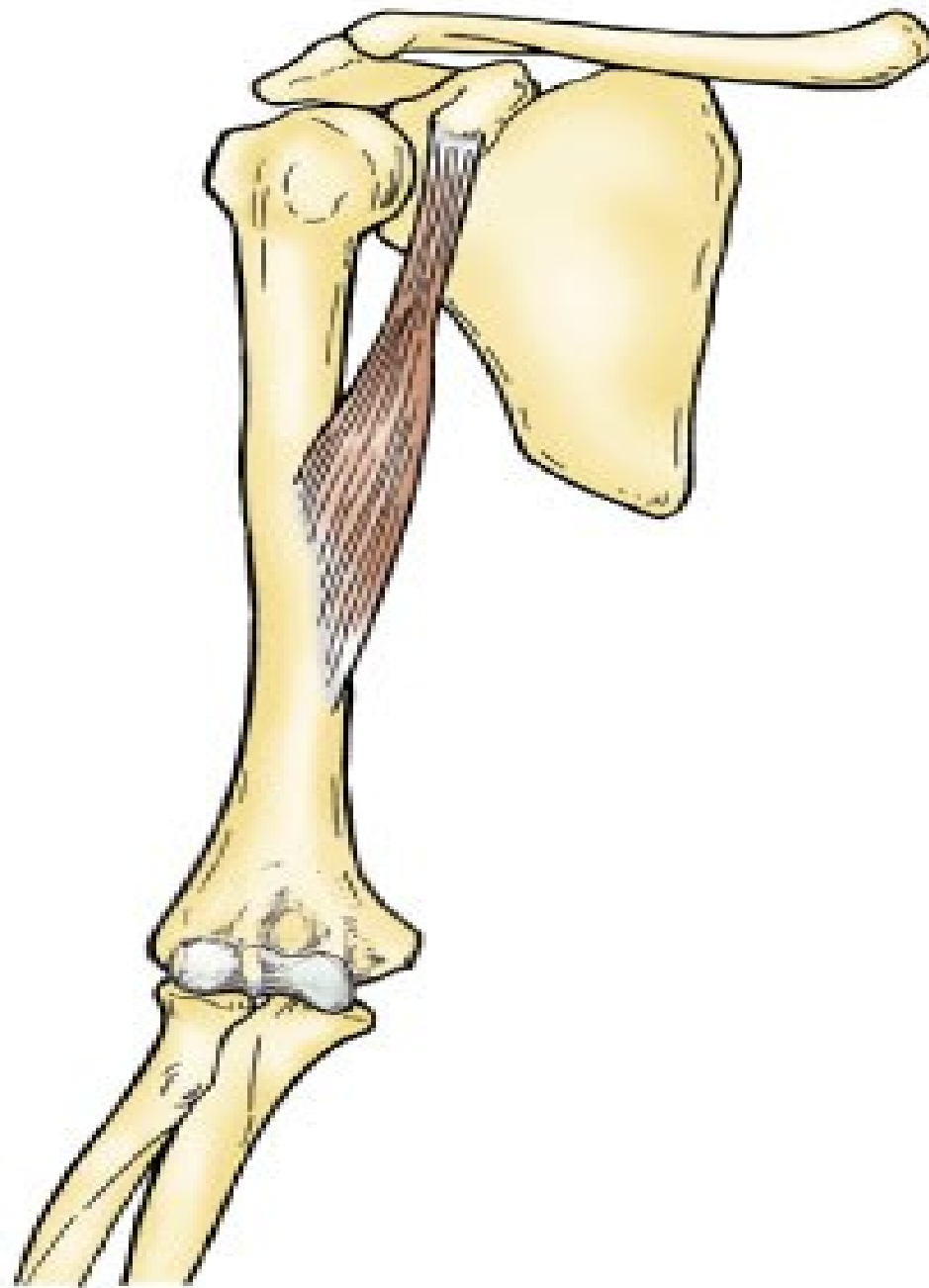
Coraco-  
brachialis

Brachialis

(c)



Mover of Upper  
Arm



**Coracobrachialis**



# Teres major

- O = Dorsal surface of inferior border of scapula
- I = Medial lip of intertubercular groove of humerus
- F = Adducts and medially rotates arm.

# Right Shoulder, Anterior View

Subacromial bursa

Clavicle

Coracobrachialis  
m.

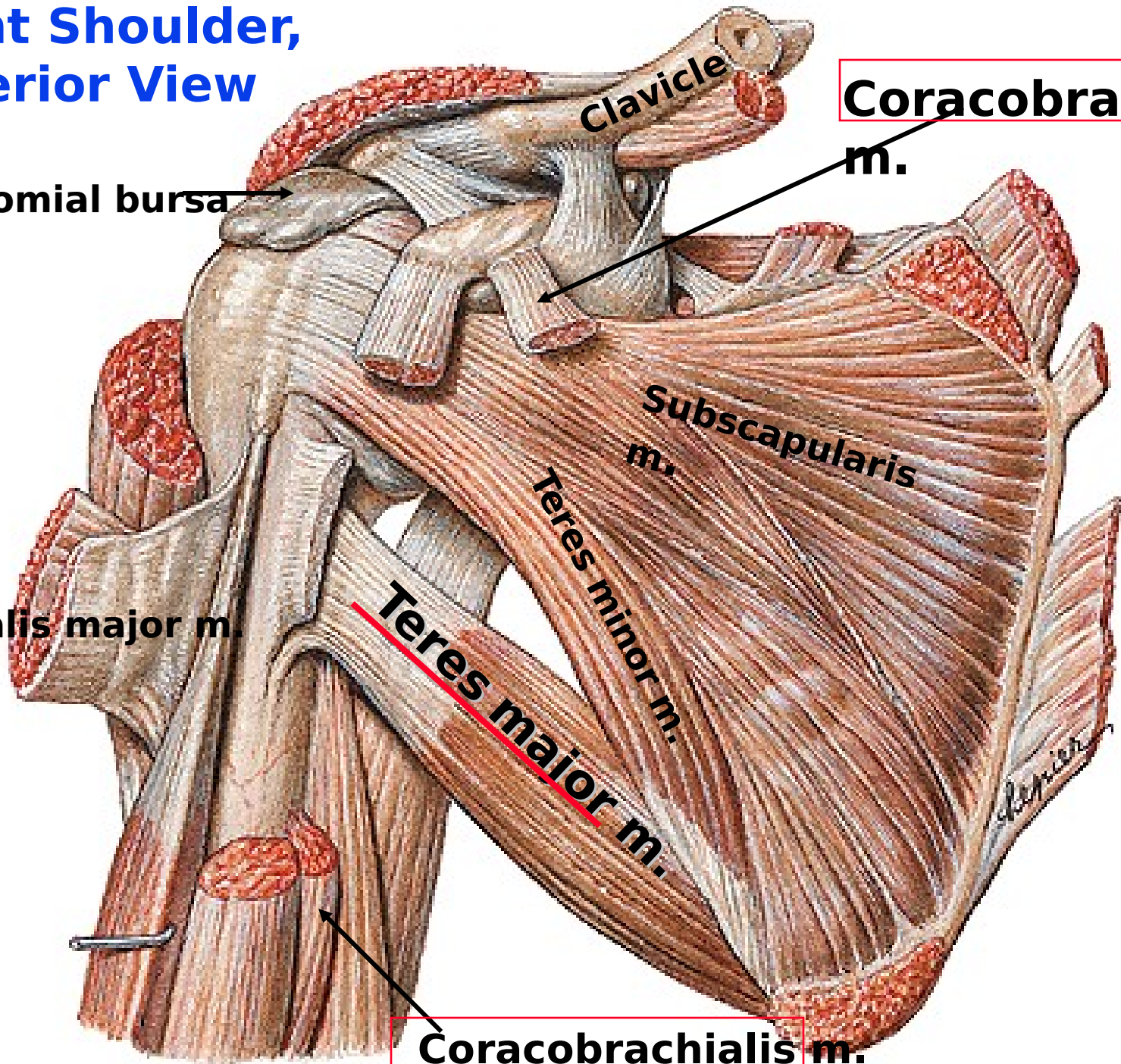
Subscapularis  
m.

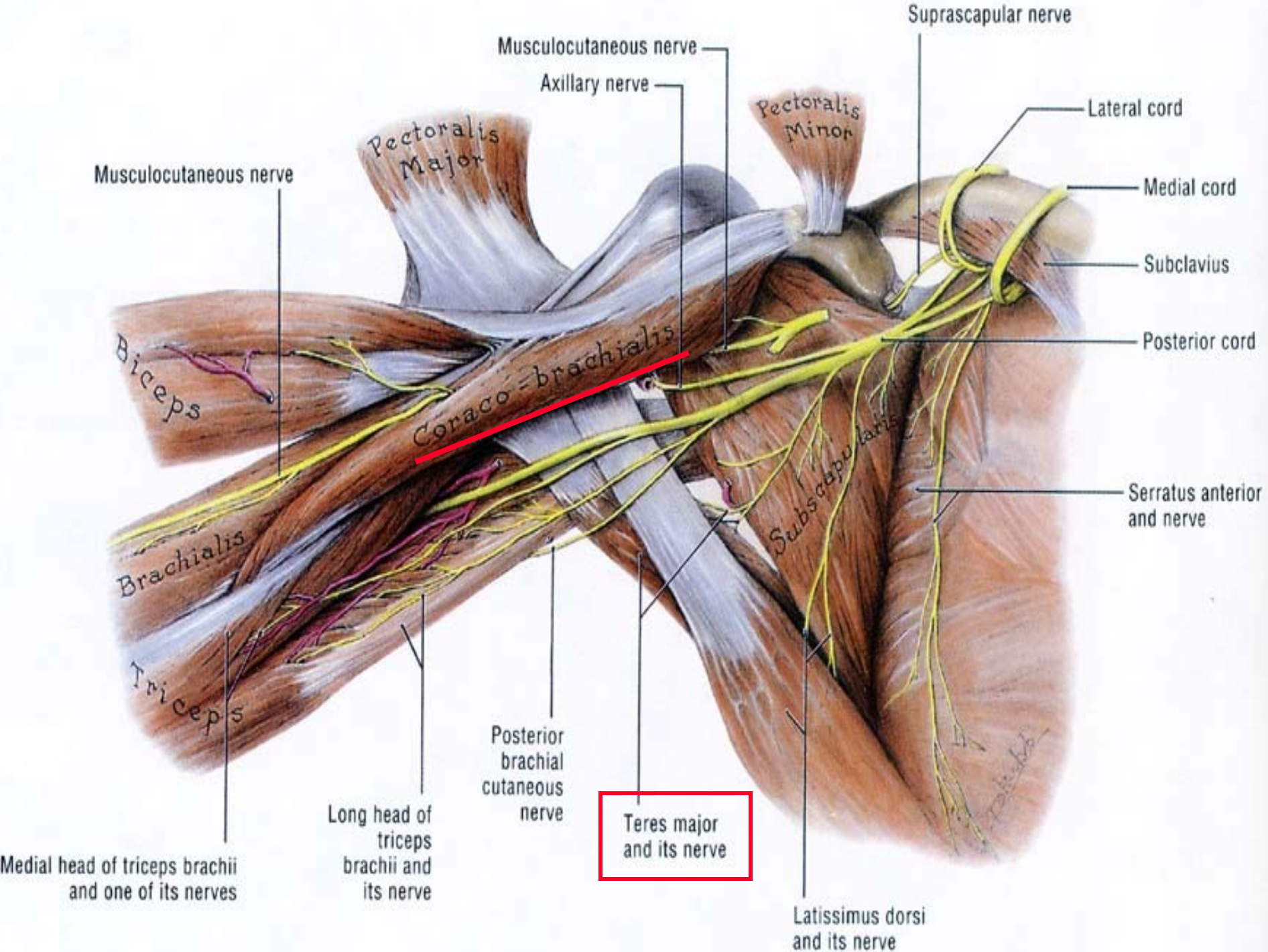
Teres minor m.

Teres major m.

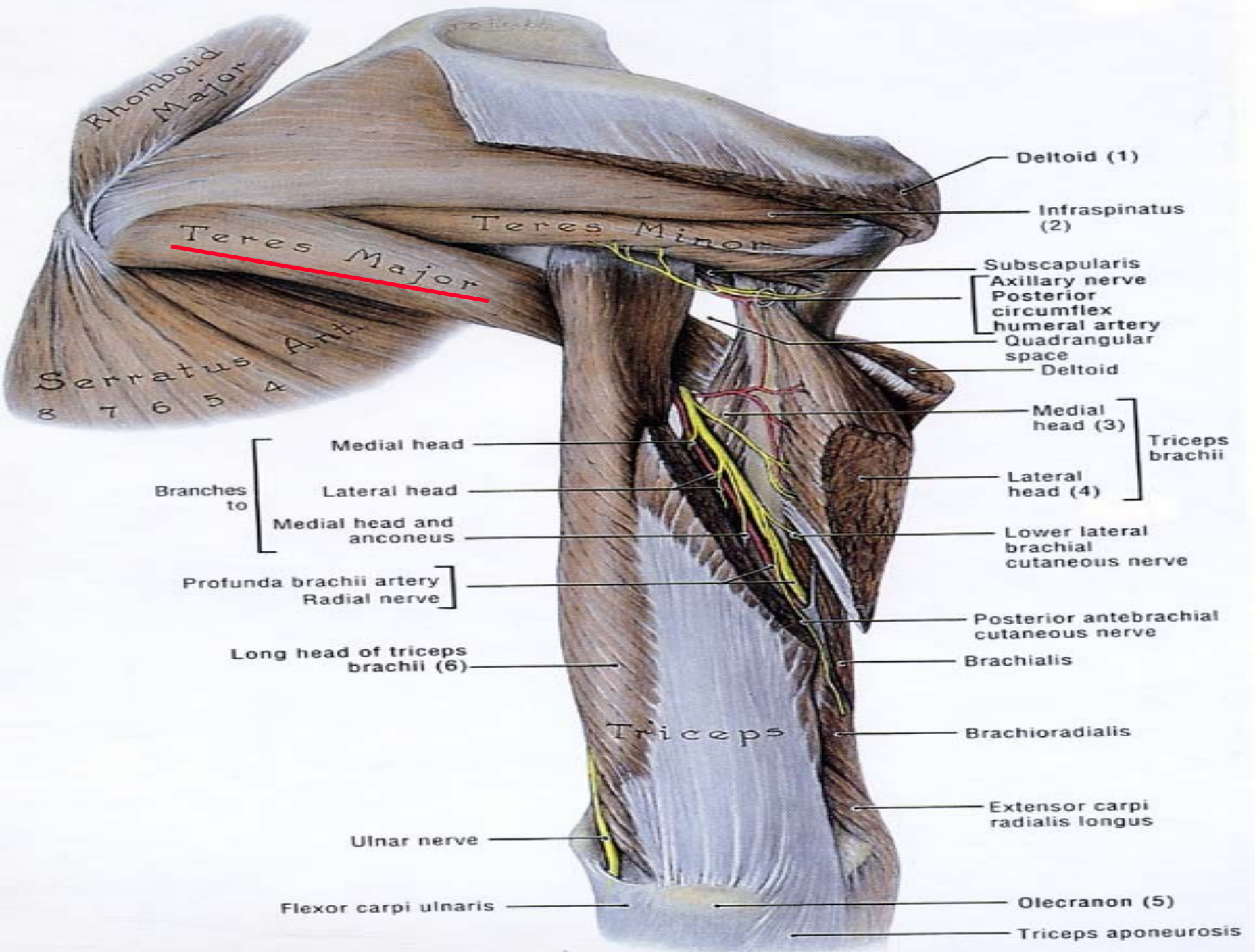
Pectoralis major m.

Coracobrachialis m.











Anterior branches of  
lateral cutaneous branches of  
2nd and 3rd intercostal nerves

Coracobrachialis

Biceps brachii,  
short head

Brachialis and median nerve

Coracobrachialis  
Musculocutaneous nerve

Cephalic vein

Deltoid

Radial nerve and  
profunda brachii artery

Brachial artery and  
basilic vein

Ulnar nerve

Intercostobrachial nerves

Teres major and lower subscapular nerve

Nerve to long head of  
triceps and posterior cutaneous  
nerve of arm

Pectoralis major

Pectoralis minor

Lateral thoracic artery

Subscapularis and  
upper subscapular nerve

Subscapular artery

Serratus anterior and  
long thoracic nerve

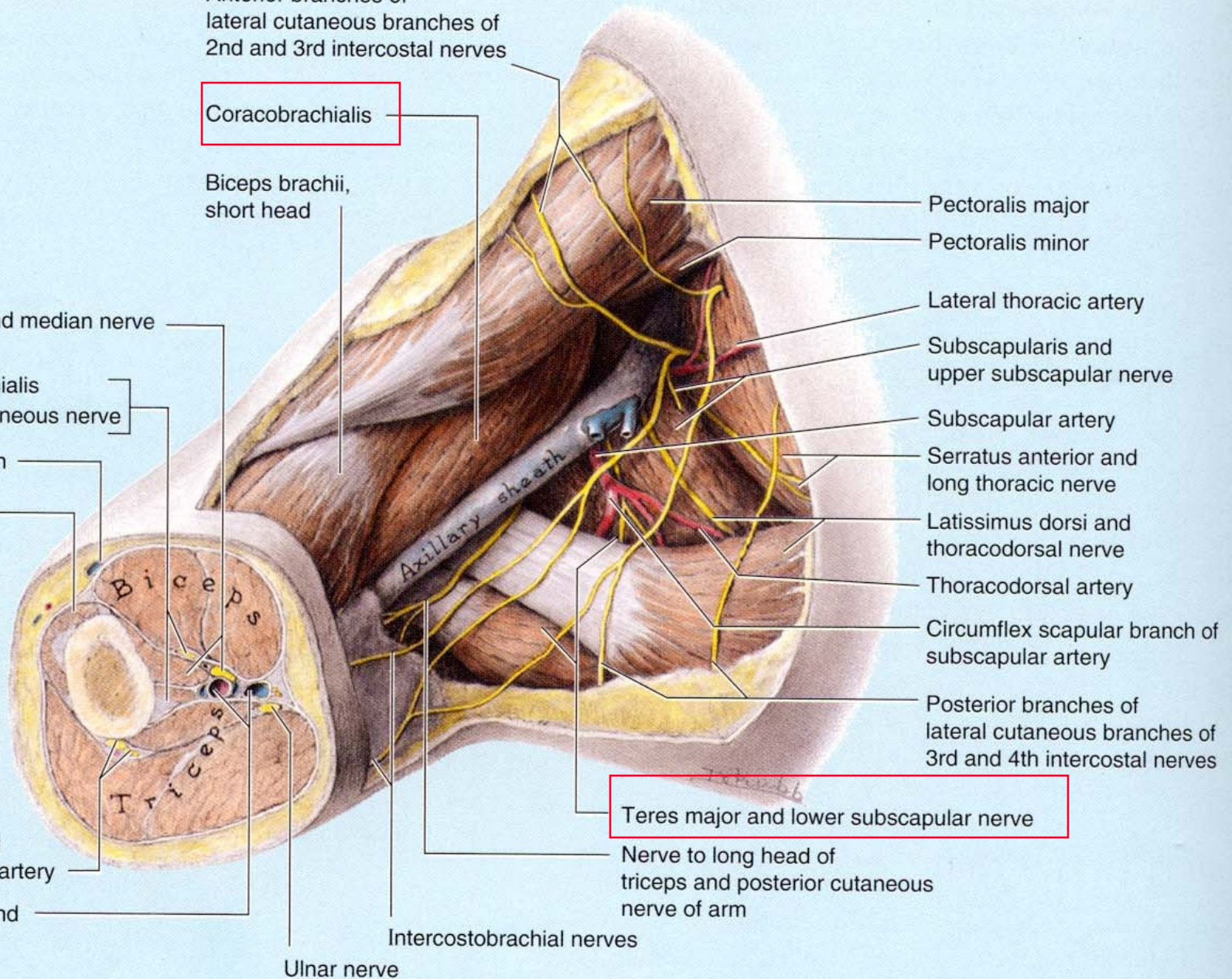
Latissimus dorsi and  
thoracodorsal nerve

Thoracodorsal artery

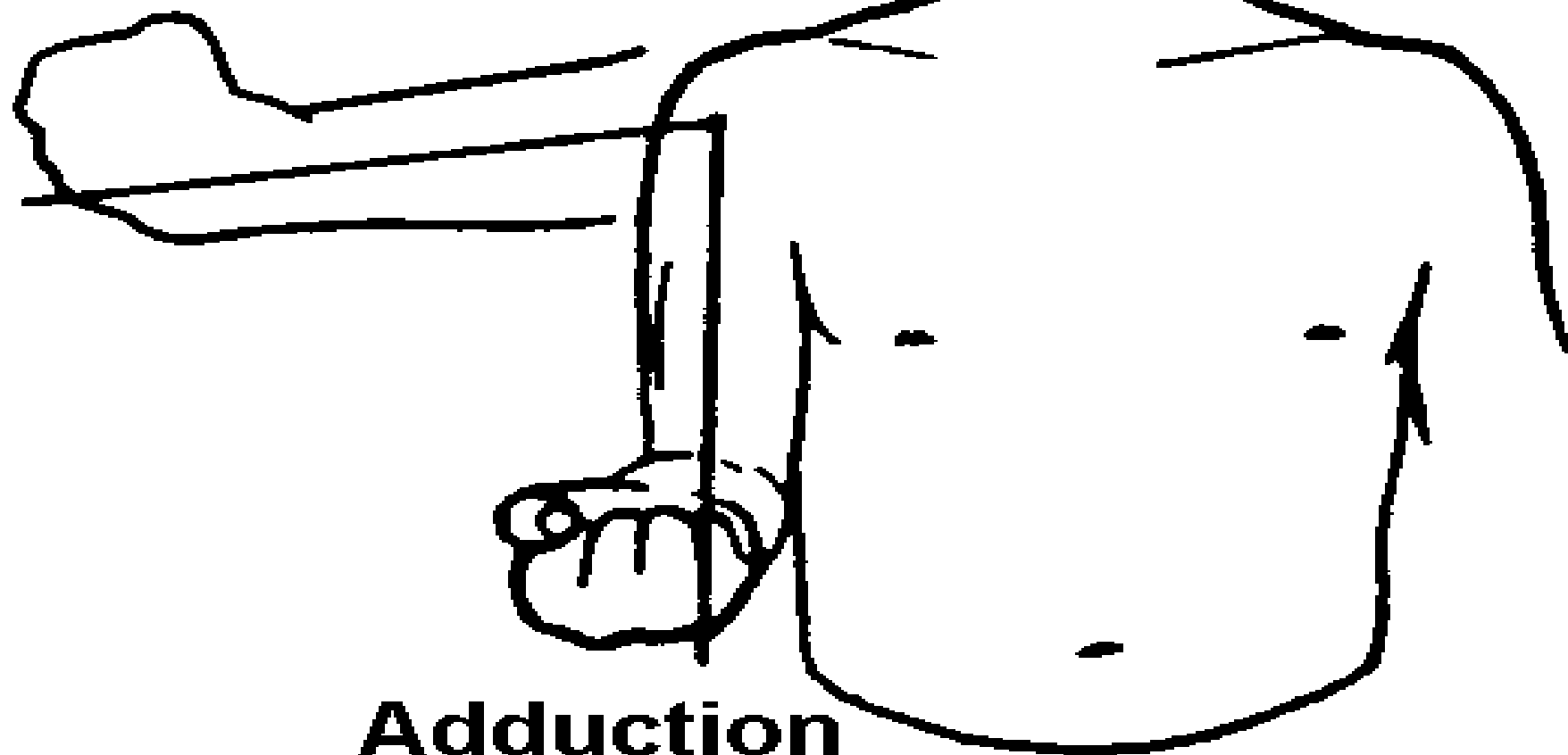
Circumflex scapular branch of  
subscapular artery

Posterior branches of  
lateral cutaneous branches of  
3rd and 4th intercostal nerves

Inferior view

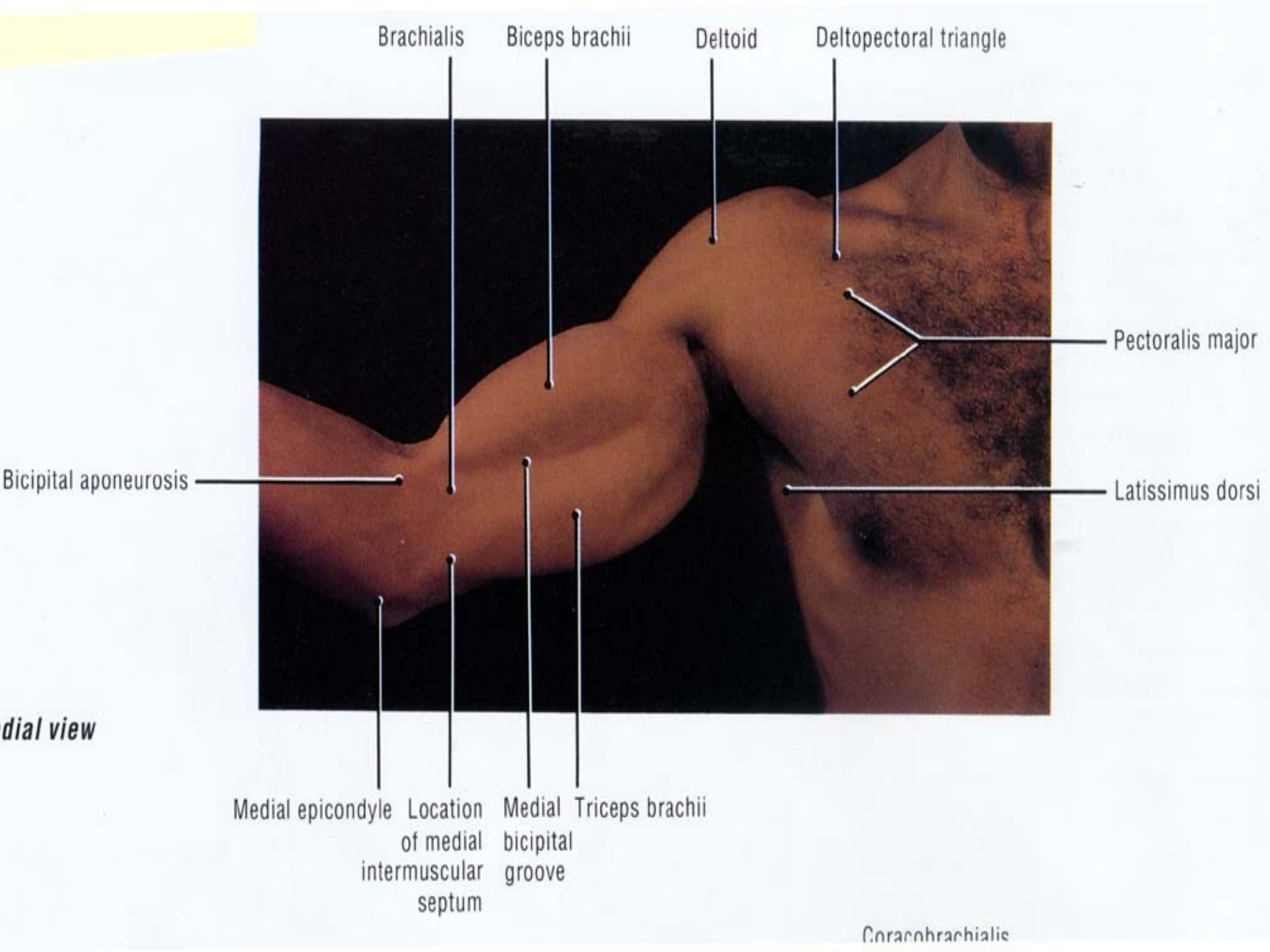


**Abduction**



# **Muscles Crossing the Elbow Joint: Flexion & Extension of the Forearm**







# Muscles of the Elbow Joint

- Since the elbow is a **hinge joint**, movements promoted by these muscles are limited almost entirely to **flexion** & **extension** of the forearm.
- The fascia divide the arm into 2 compartments – *anterior flexors* & *posterior extensors*.

**Humerus**

**Anterior  
compartment**

**Medial  
intermuscular  
septum**

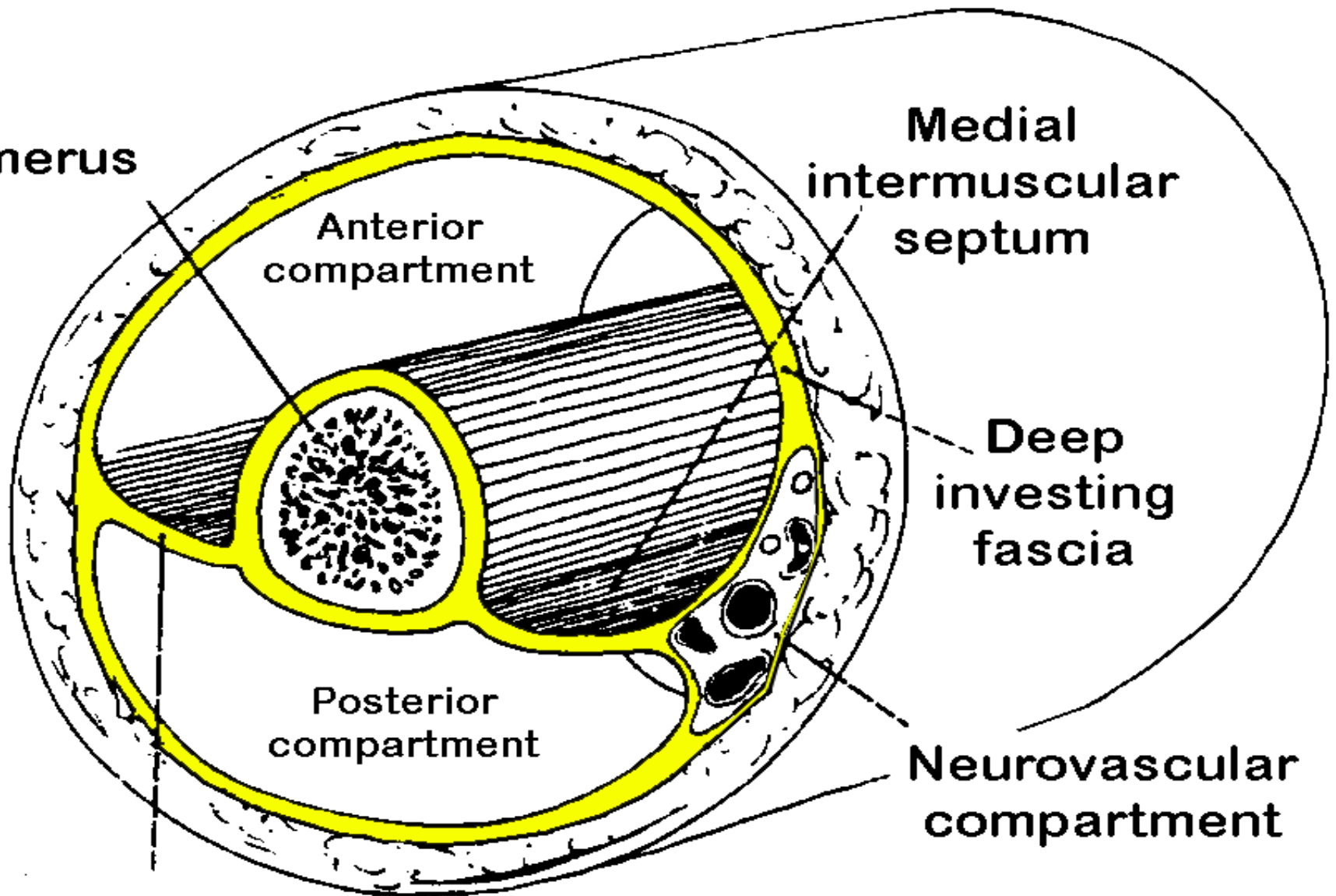
**Deep  
investing  
fascia**

**Posterior  
compartment**




**Neurovascular  
compartment**

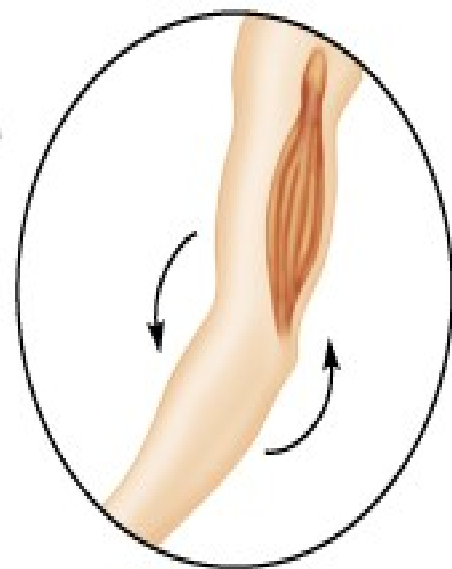
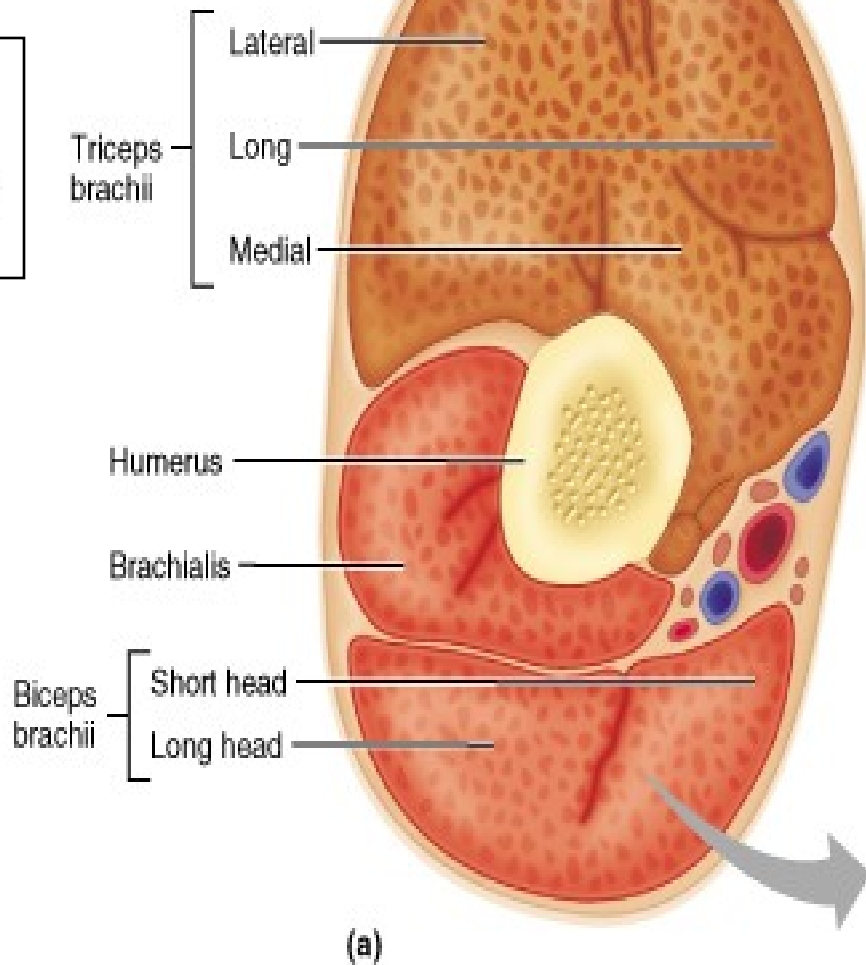
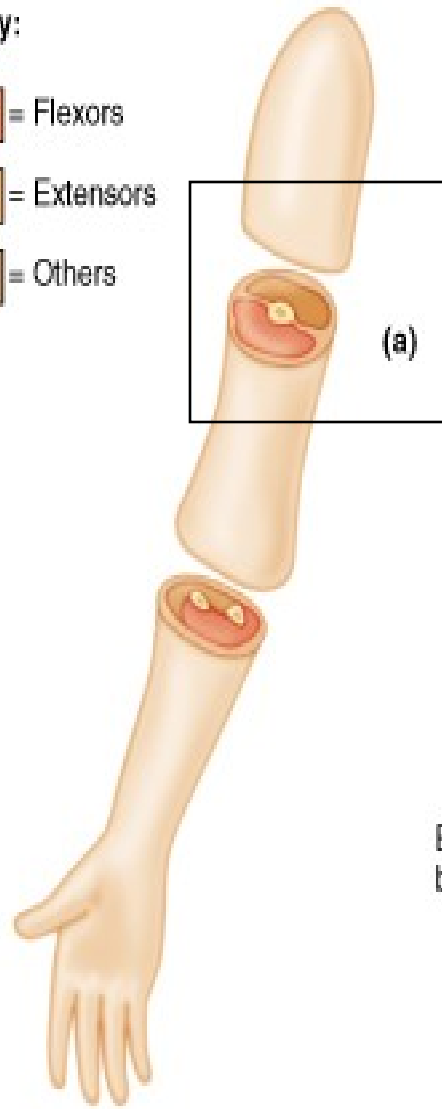
**Lateral  
intermuscular  
septum**

**Compartmentation of the Arm**

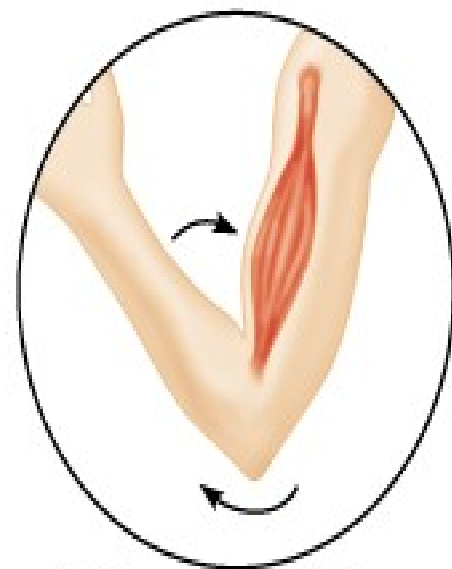


**Key:**

-  = Flexors
-  = Extensors
-  = Others

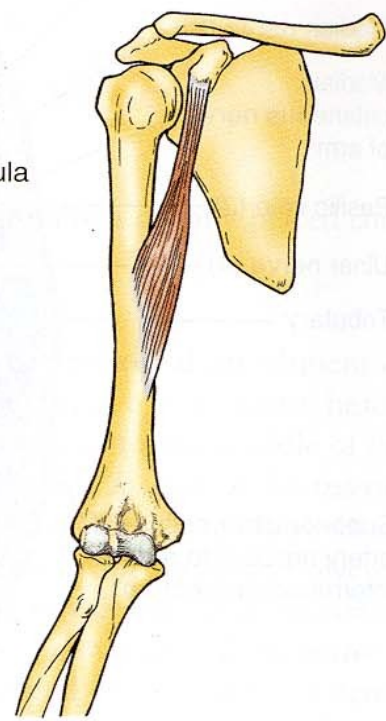
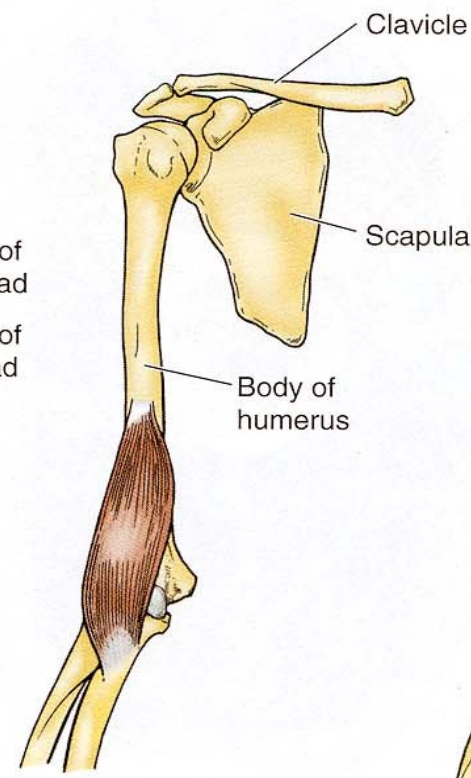
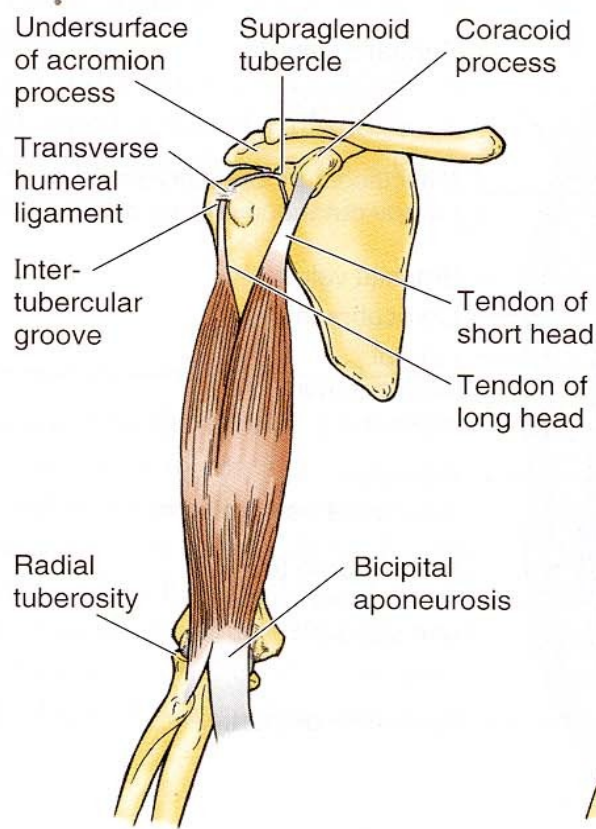
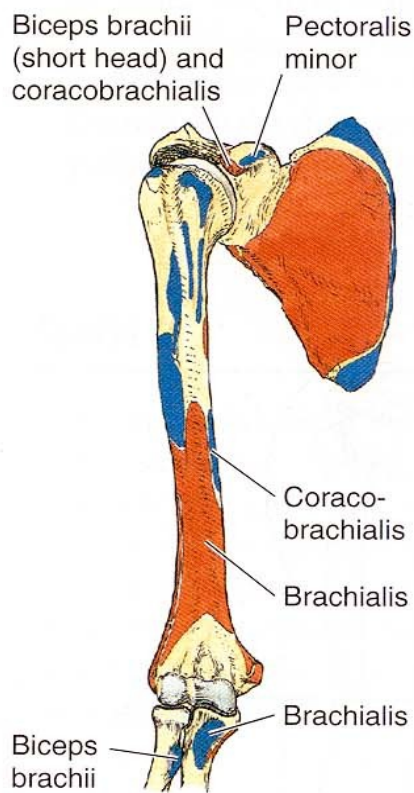


Posterior compartment of arm  
(extends elbow)



Anterior compartment of arm  
(flexes elbow)

**Table 6.5. Muscles of the Arm**



**(Anterior views)**

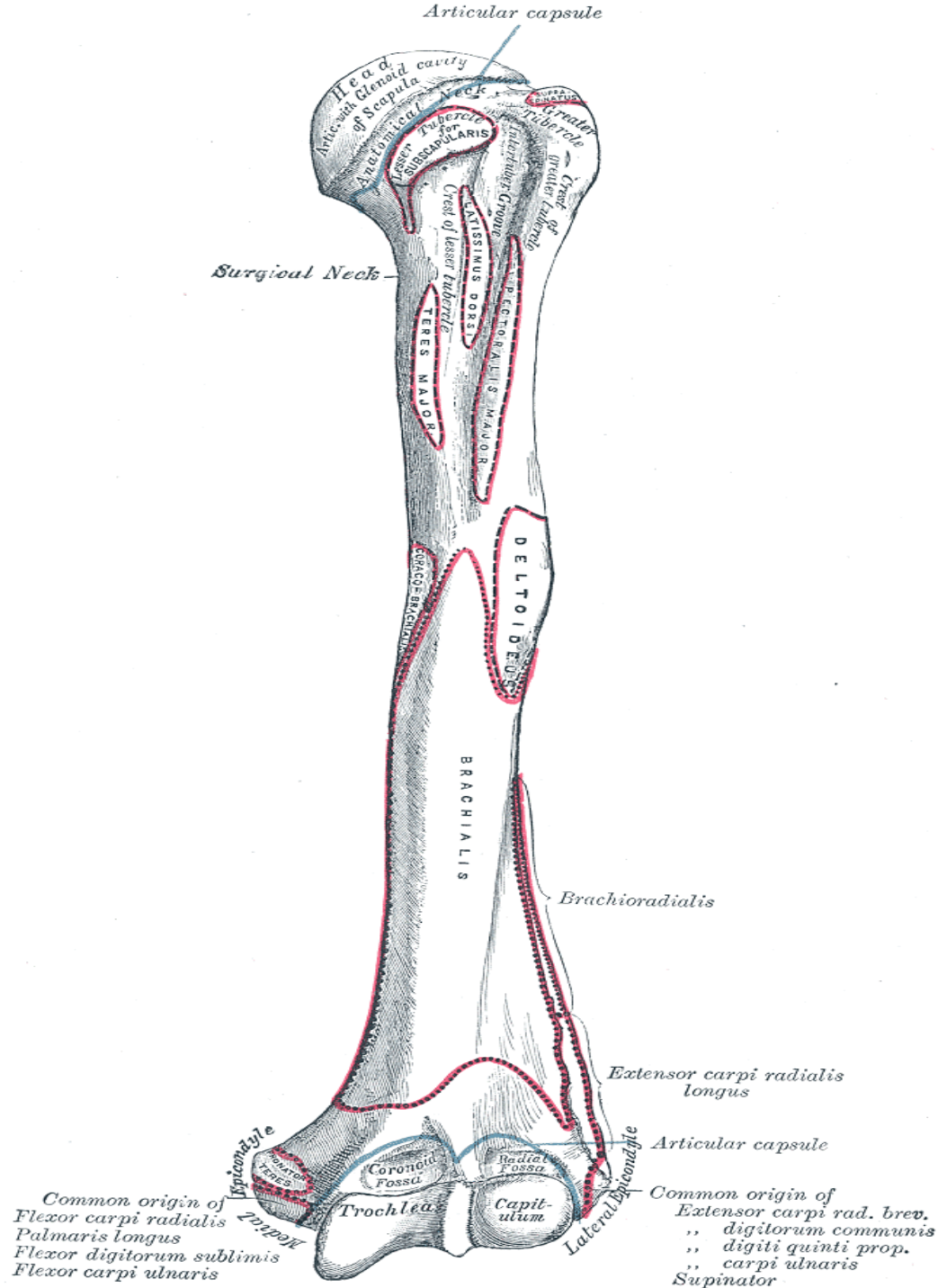
**Biceps brachii**

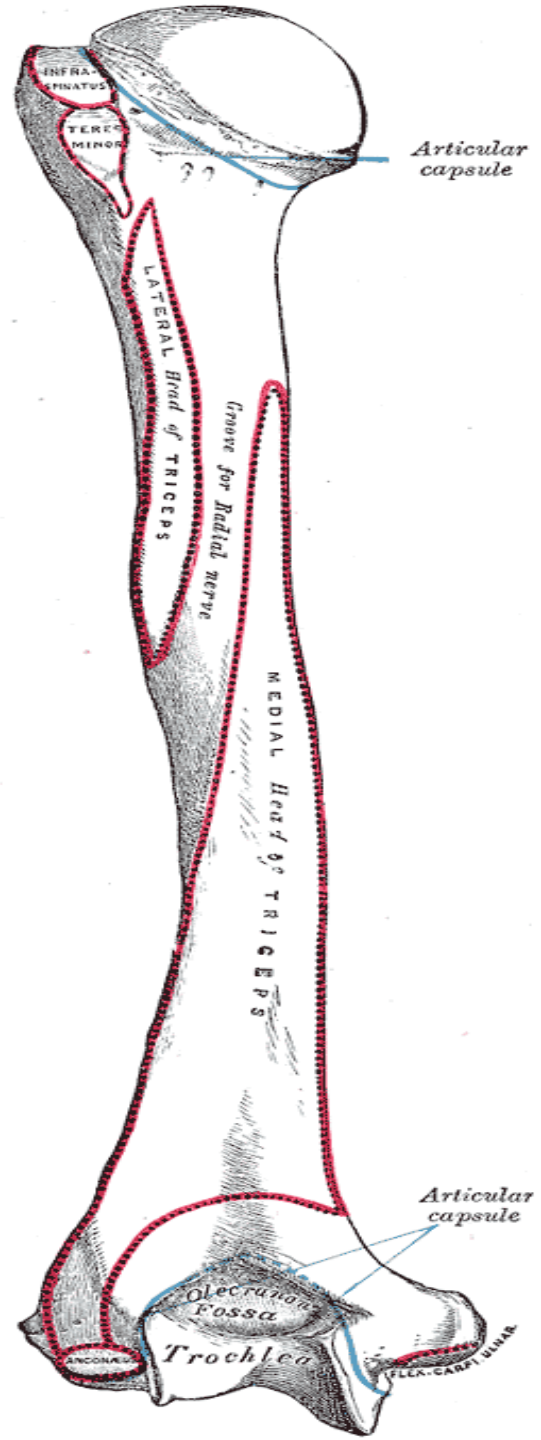
**Brachialis**

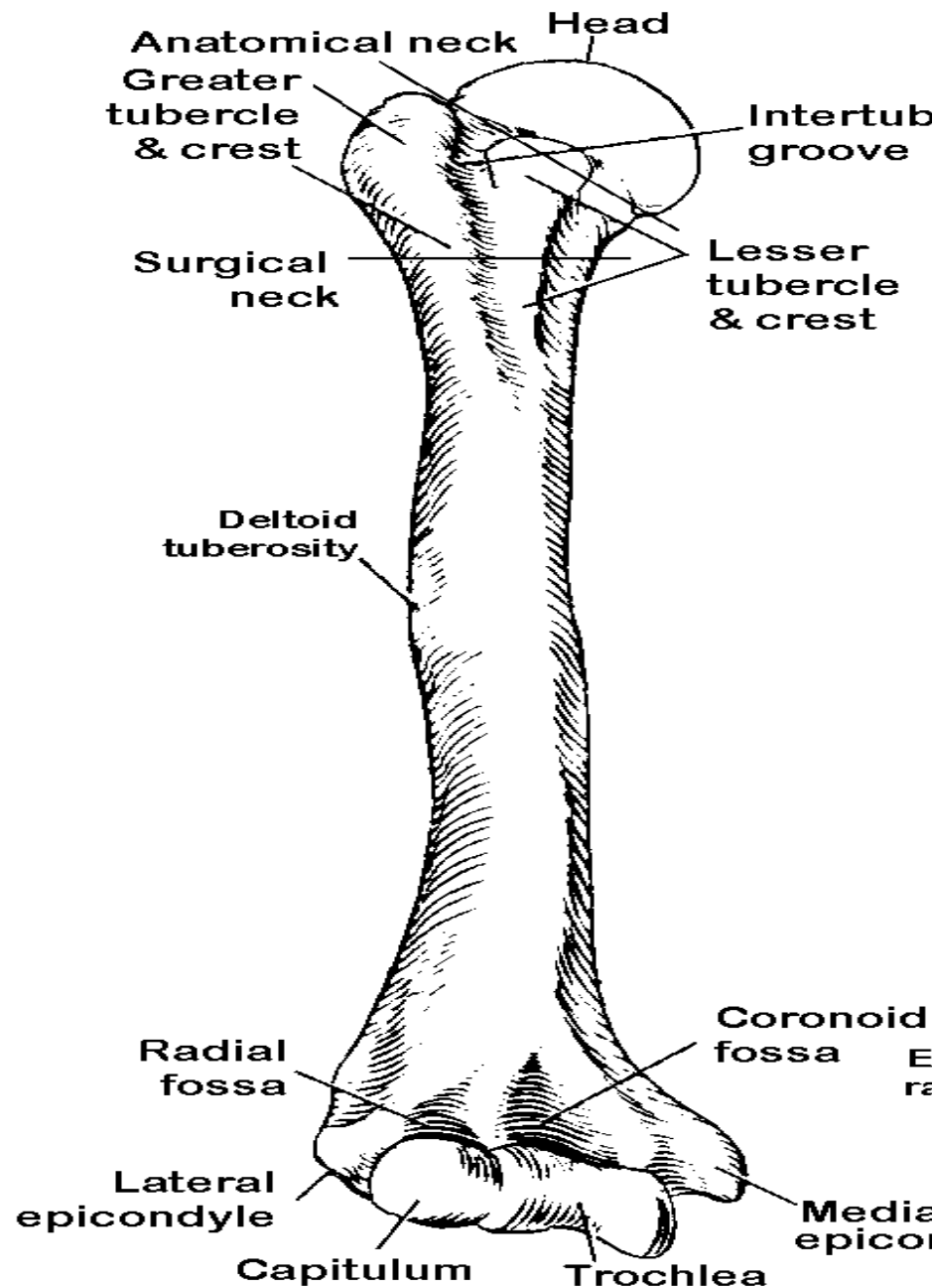
**Coracobrachialis**

Muscle	Proximal Attachment	Distal Attachment	Innervation <sup>a</sup>	Main Action
Biceps brachii	Short head: tip of coracoid process of scapula Long head: supraglenoid tubercle of scapula	Tuberosity of radius and fascia of forearm via bicipital aponeurosis	Musculocutaneous nerve <sup>b</sup> (C5 and C6)	Supinates forearm and, when it is supine, flexes forearm
Brachialis	Distal half of anterior surface of humerus	Coronoid process and tuberosity of ulna		Flexes forearm in all positions
Coracobrachialis	Tip of coracoid process of scapula	Middle third of medial surface of humerus	Musculocutaneous nerve (C5, C6, and C7)	Helps to flex and adduct arm

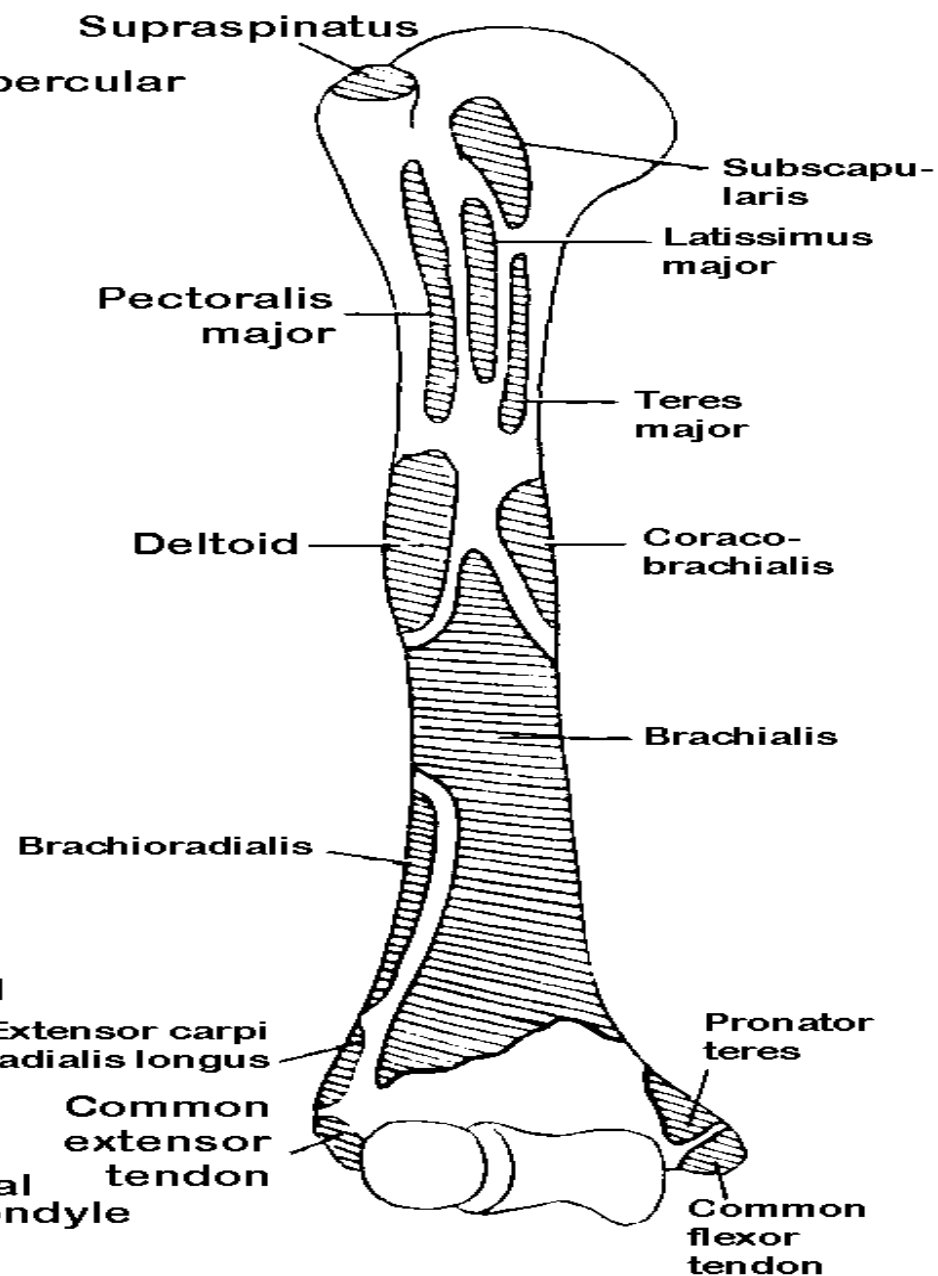








**Anterior view of the right humerus**



**Muscular attachments**

# **Flexors & Extensors of the Forearm**

- ***Anterior Flexors***

- Biceps brachii
- Brachialis
- Brachioradialis

- ***Posterior Extensors***

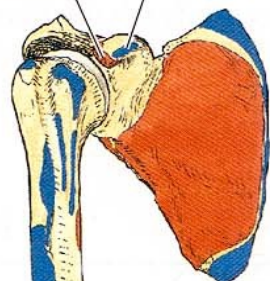
- Triceps brachii
- Anconeus



**Table 6.5. Muscles of the Arm**

Biceps brachii (short head) and coracobrachialis

Pectoralis minor



Coraco-brachialis

Brachialis

Brachialis

Biceps brachii

(Anterior views)

Undersurface of acromion process

Supraglenoid tubercle

Coracoid process

Transverse humeral ligament

Inter-tubercular groove

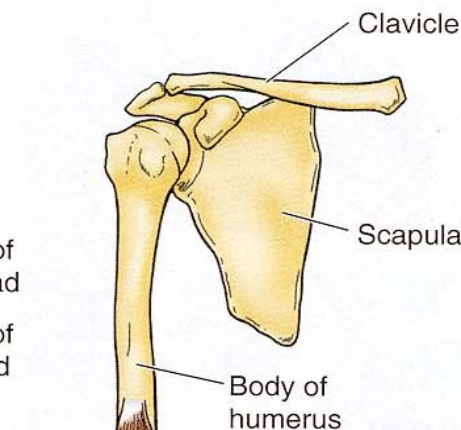
Tendon of short head

Tendon of long head

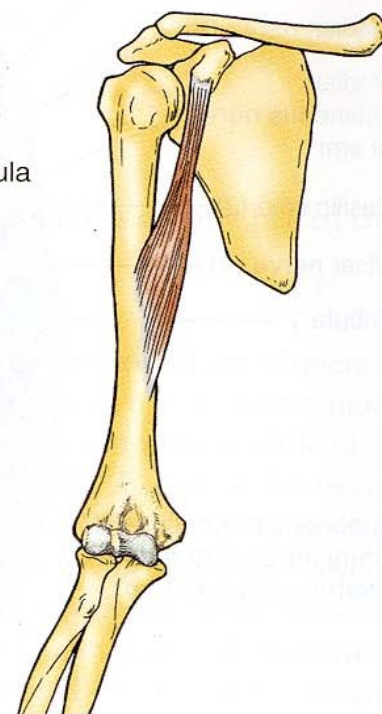
Radial tuberosity

Bicipital aponeurosis

Biceps brachii



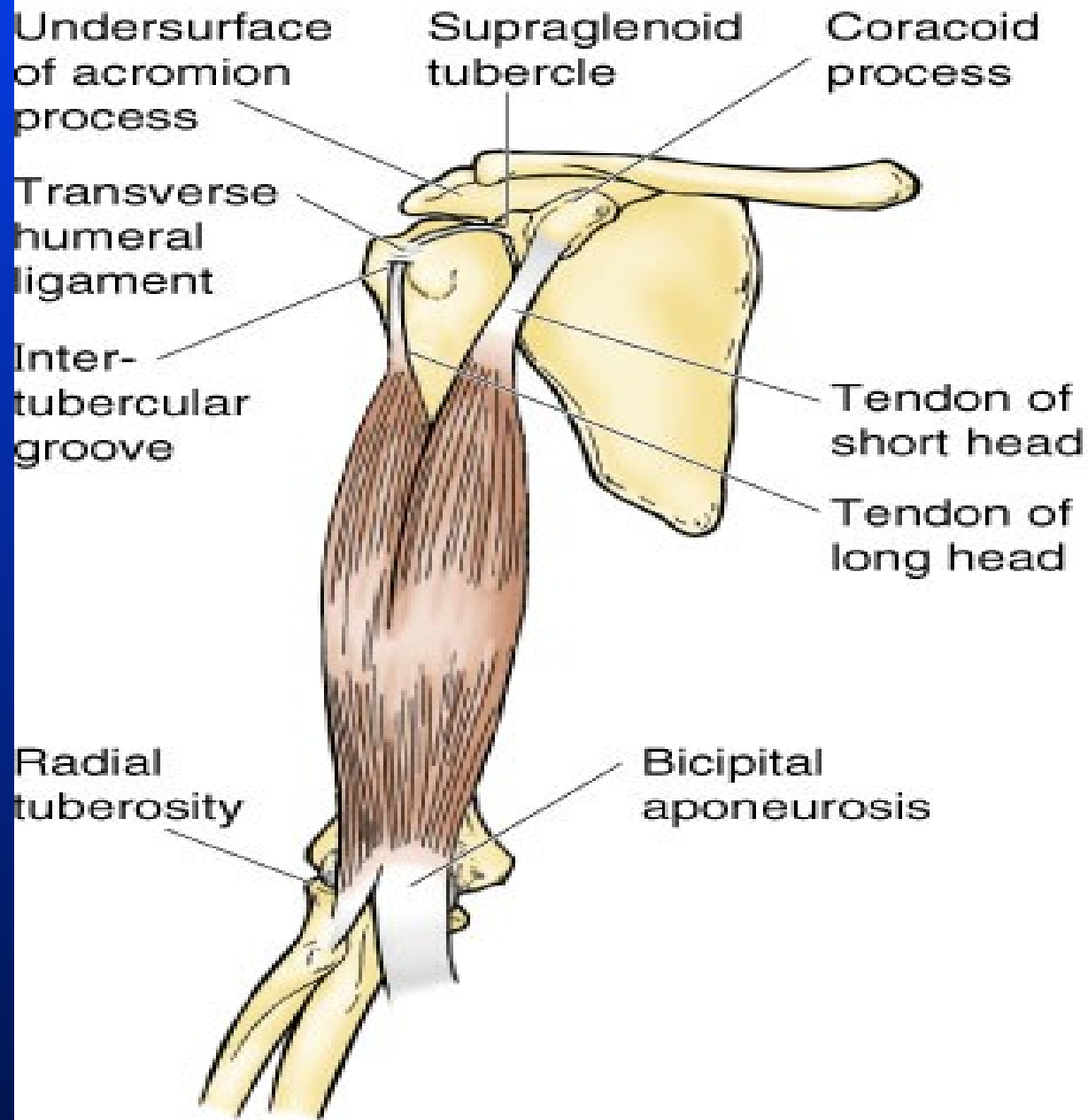
Brachialis



Coracobrachialis

Muscle	Proximal Attachment	Distal Attachment	Innervation <sup>a</sup>	Main Action
Biceps brachii	Short head: tip of coracoid process of scapula Long head: supraglenoid tubercle of scapula	Tuberosity of radius and fascia of forearm via bicipital aponeurosis	Musculocutaneous nerve <sup>b</sup> (C5 and C6)	Supinates forearm and, when it is supine, flexes forearm
Brachialis	Distal half of anterior surface of humerus	Coronoid process and tuberosity of ulna		Flexes forearm in all positions
Coracobrachialis	Tip of coracoid process of scapula	Middle third of medial surface of humerus	Musculocutaneous nerve (C5, C6, and C7)	Helps to flex and adduct arm

**Table 6.5. Muscles of the Arm**

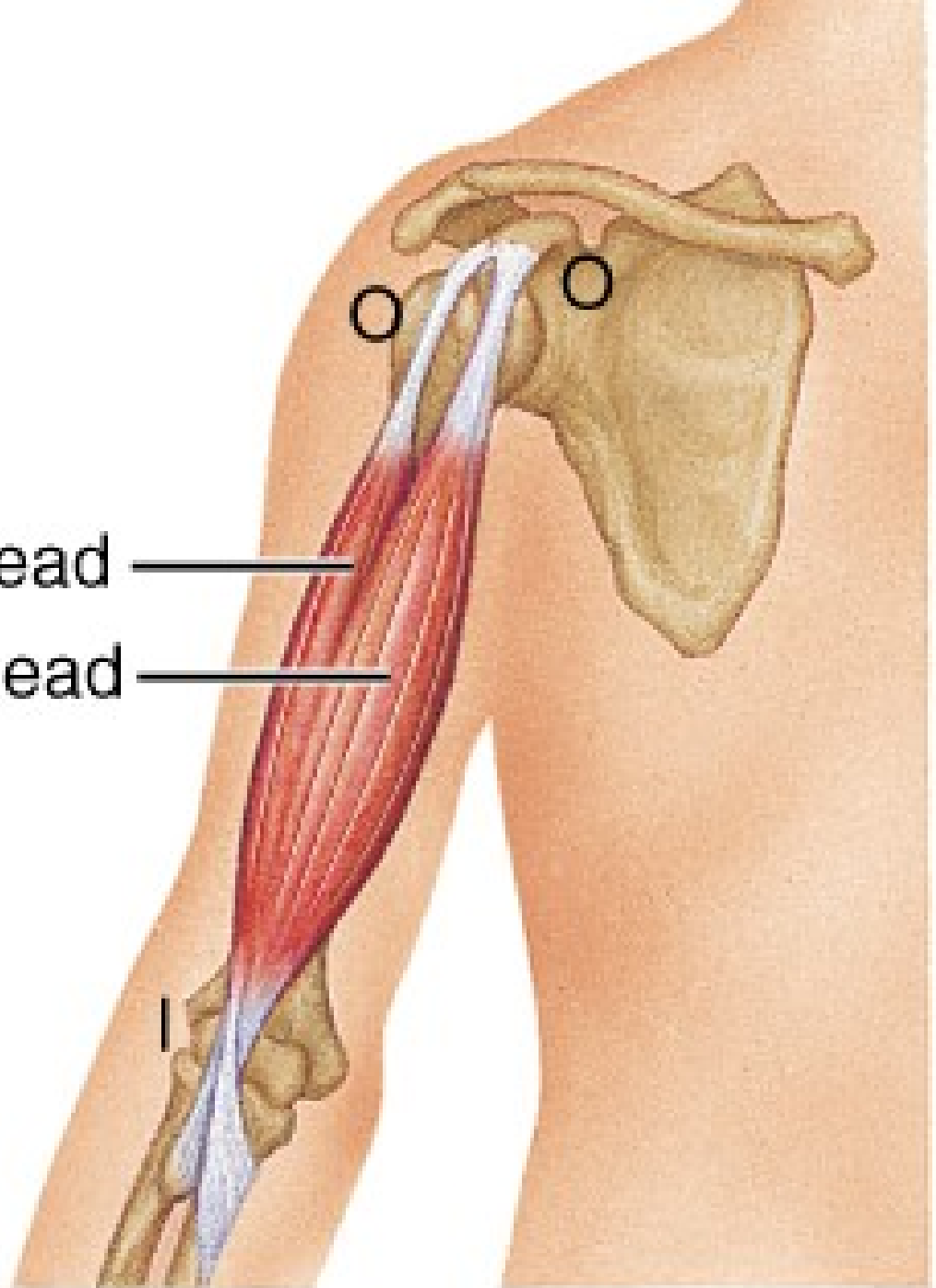


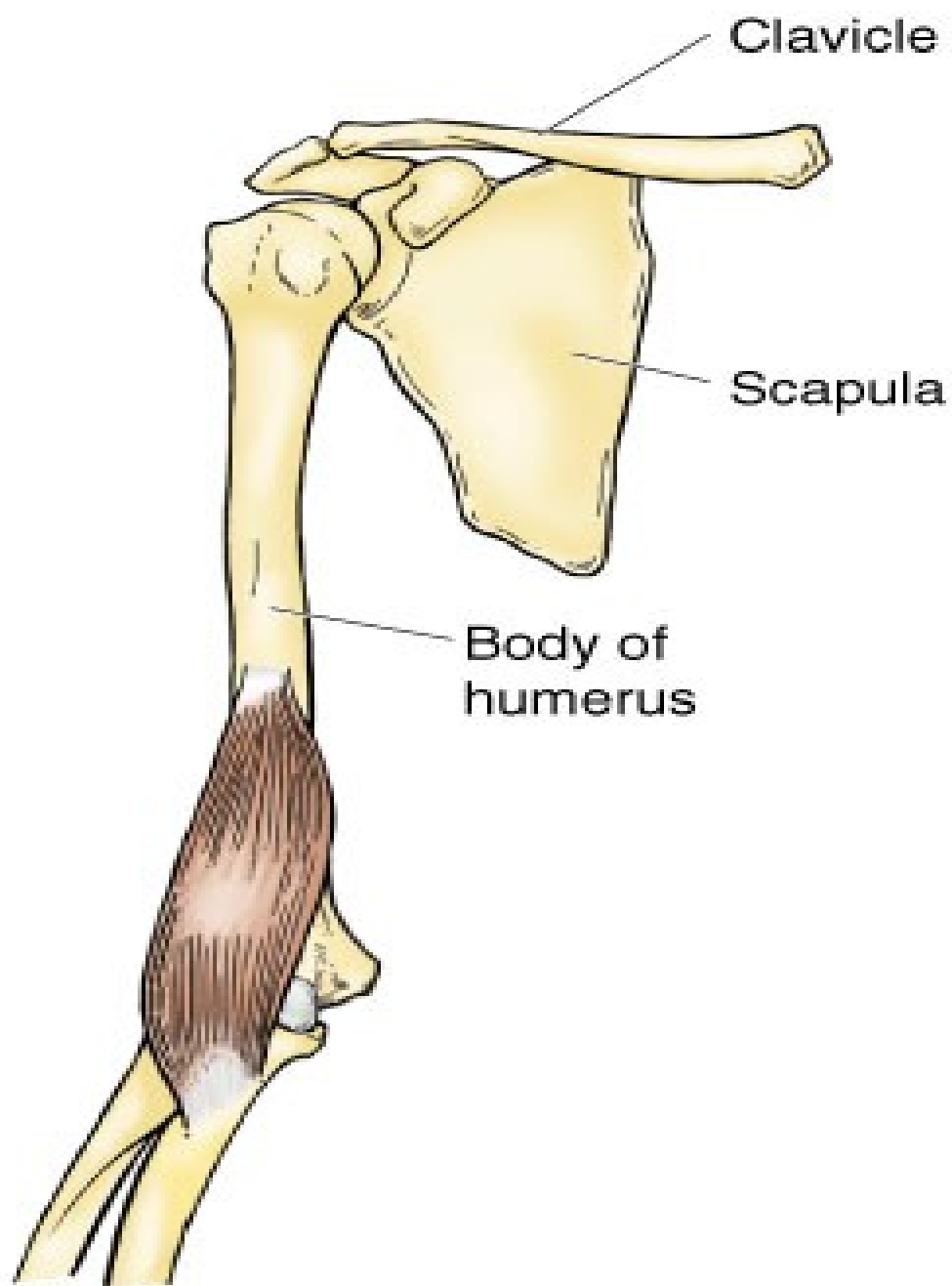
**Biceps brachii**

Biceps  
brachii — { Long head —  
Short head —

O = origin  
I = insertion

(b)



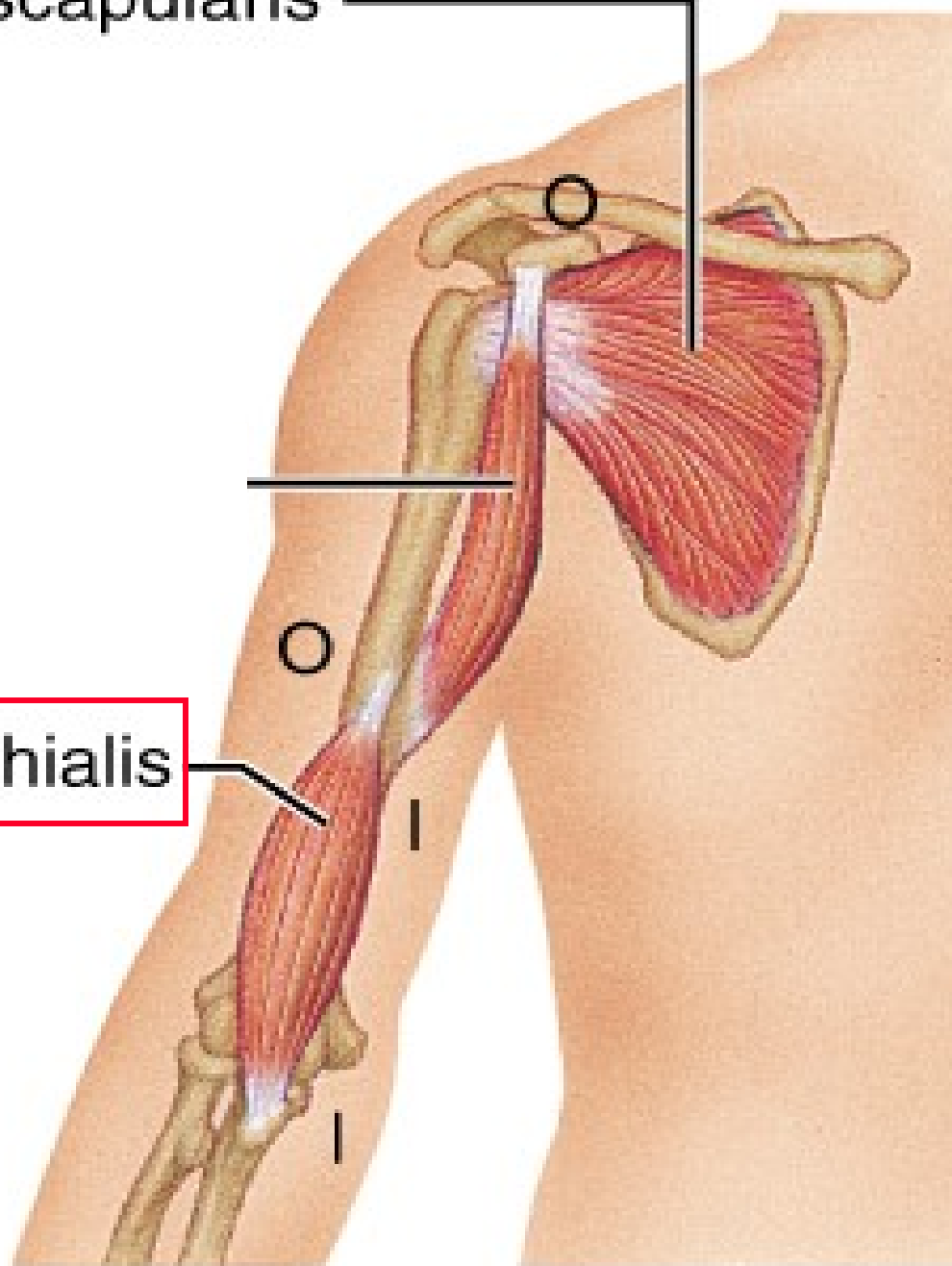


**Brachialis**

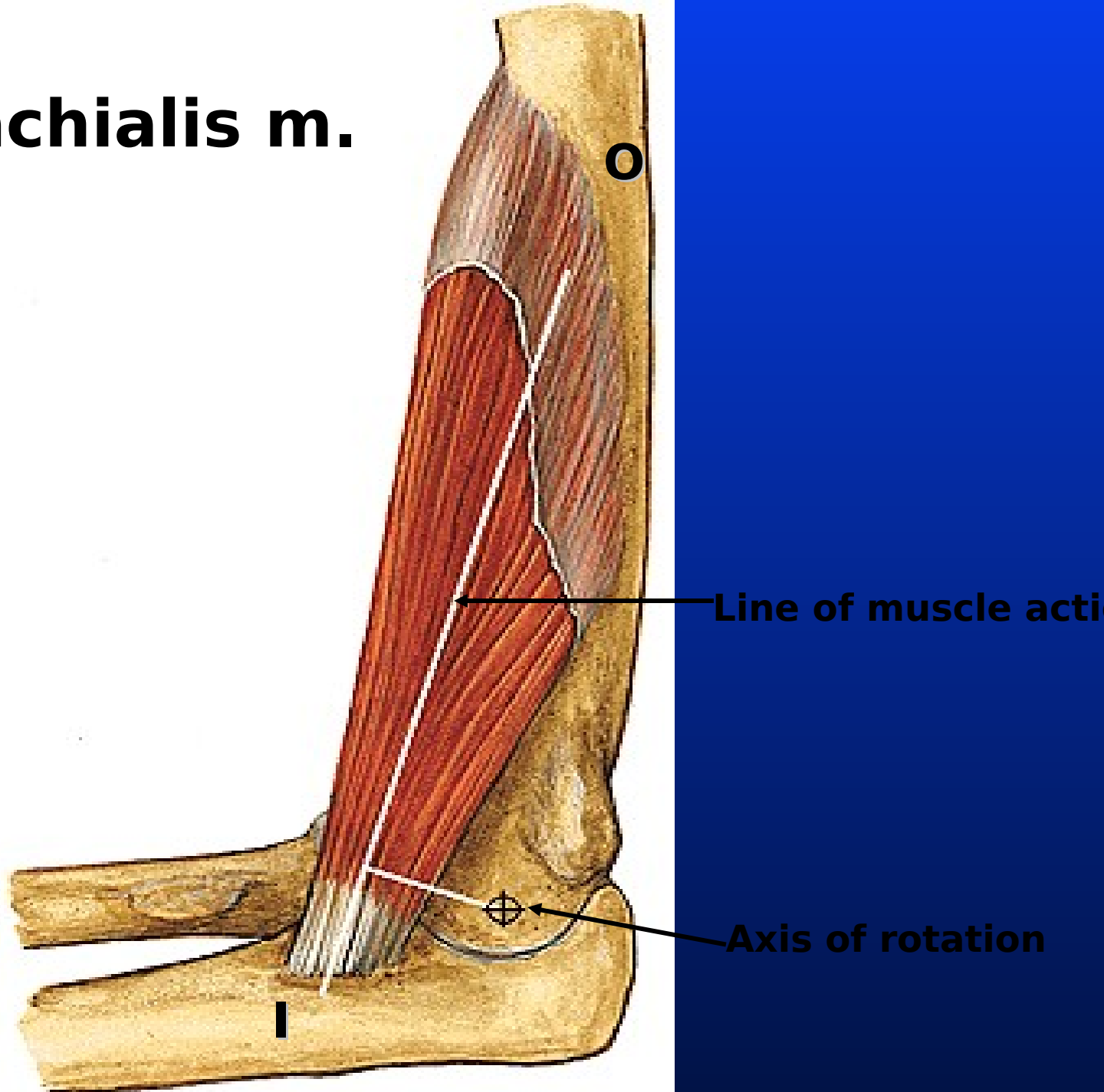
Subscapularis

Brachialis

(c)



# Brachialis m.



Clavicle

## Posterior Extensors

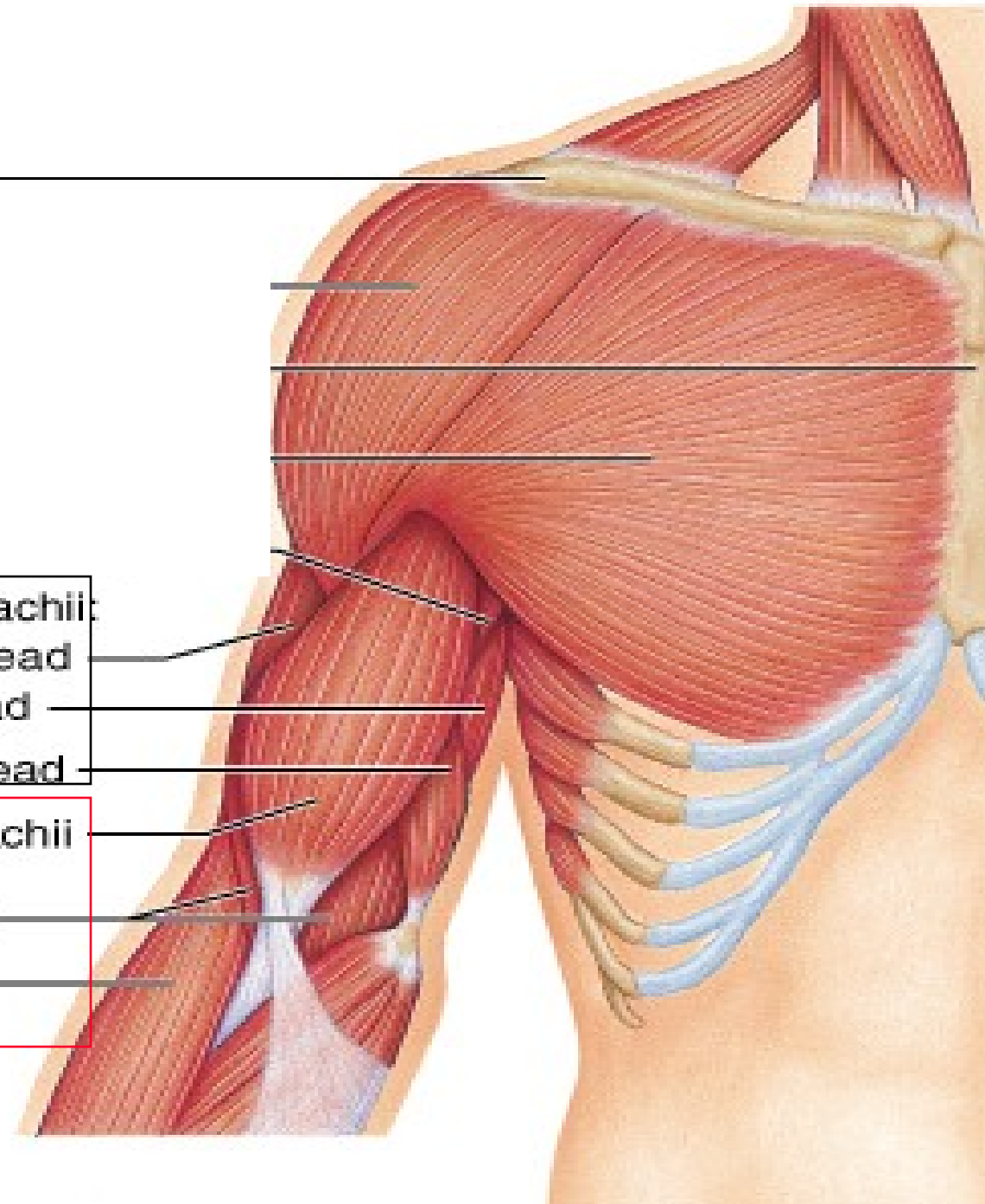
Triceps brachii

- Lateral head
- Long head
- Medial head

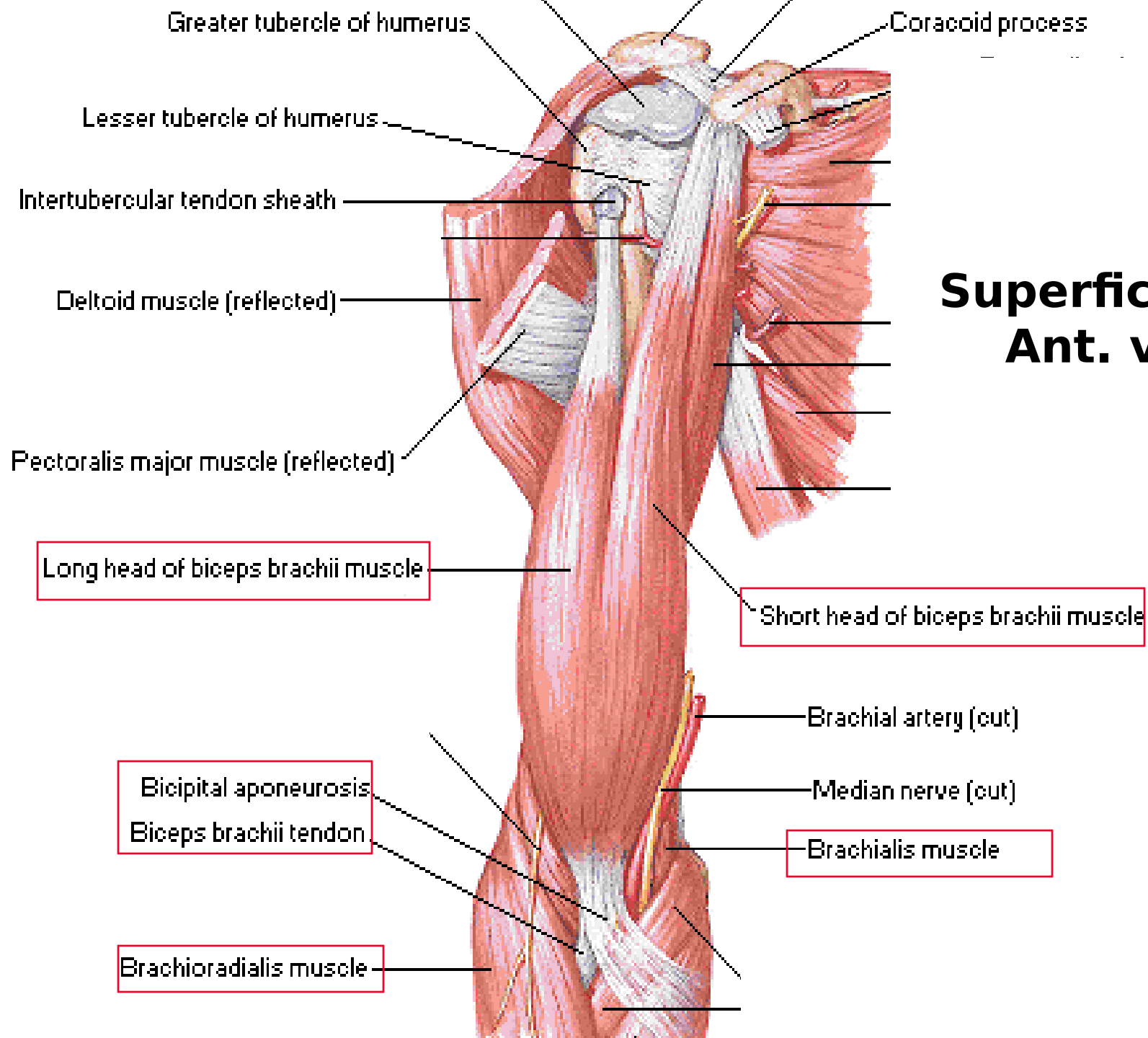
Biceps brachii

Brachialis

Brachio-  
radialis



Anterior  
Flexors



## Superficial m., Ant. view



## Deep layer m., Ant. view

Short head of biceps brachii tendon (cut)

Long head of biceps brachii tendon (cut)

Coracobrachialis muscle

Musculocutaneous nerve

Deltoid muscle (cut)

O  
=

**Brachialis m.**

Lateral epicondyle (of humerus)

Medial epicondyle (of humerus)

Lateral cutaneous nerve of forearm

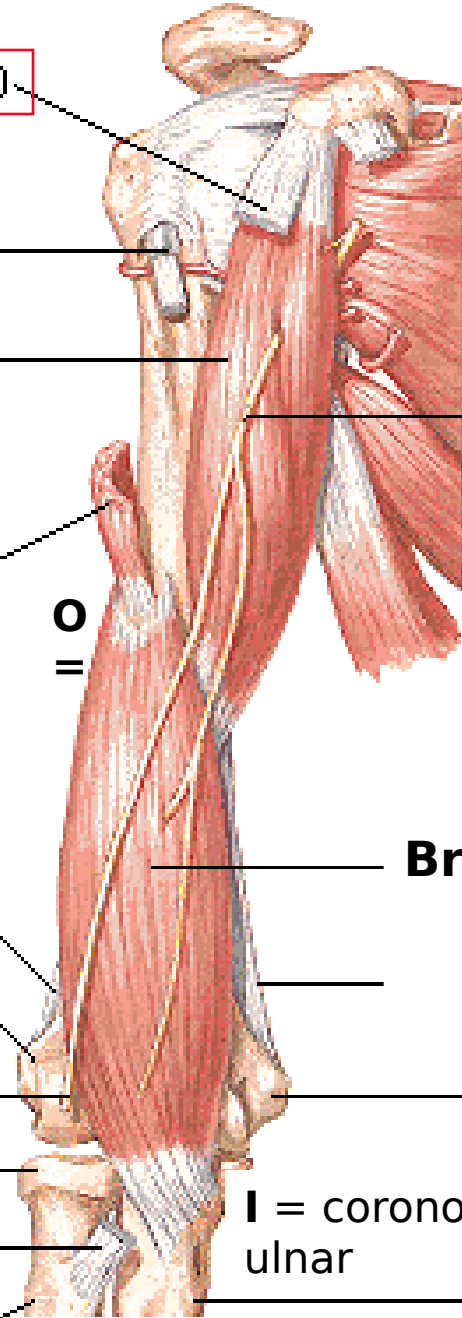
Head of radius

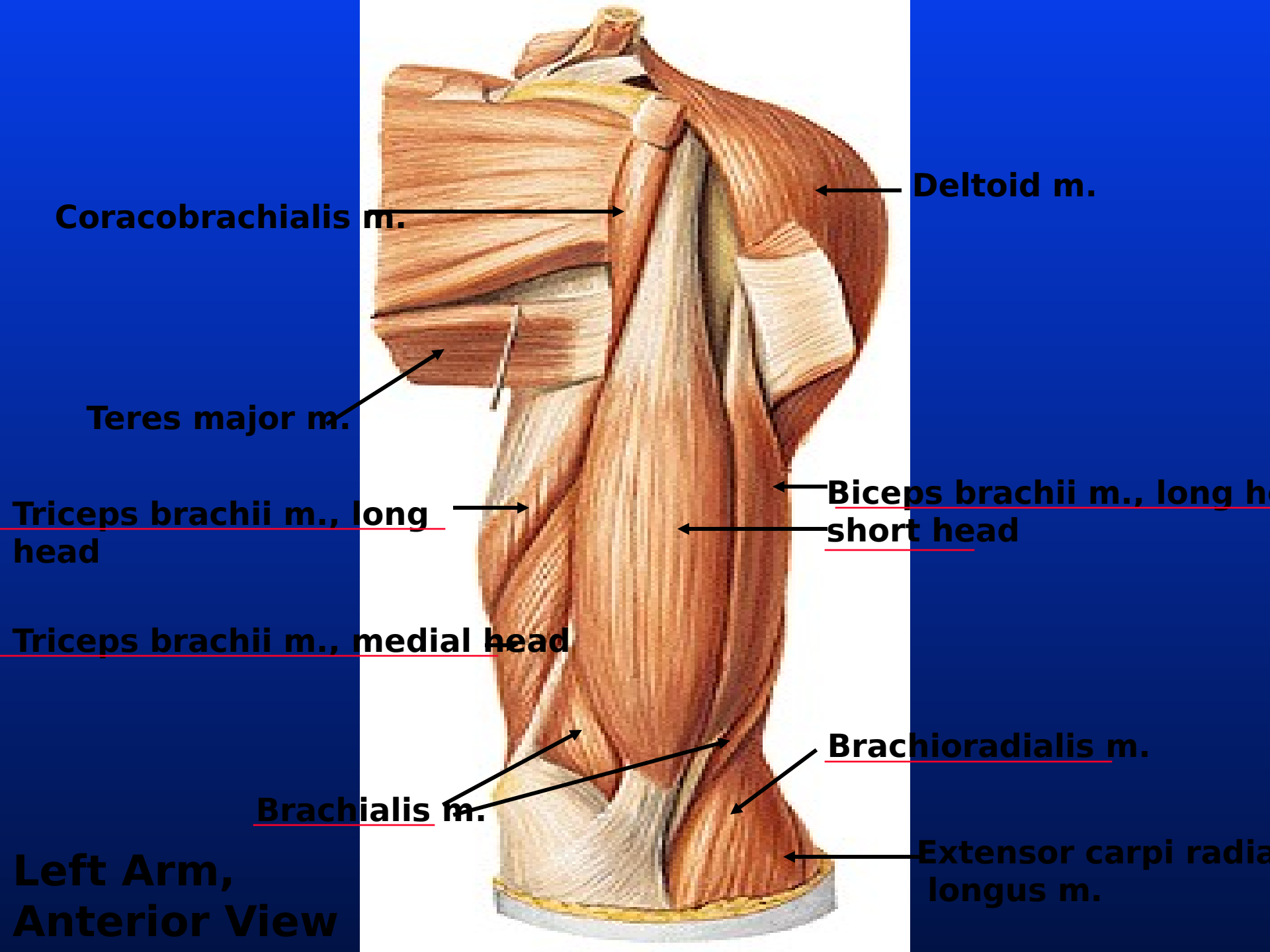
Biceps brachii tendon

I = coronoid process of  
ulnar

I = tuberosity of ulna

Radial tuberosity





**Coracobrachialis m.**

**Deltoid m.**

**Teres major m.**

**Triceps brachii m., long head**

**Biceps brachii m., long head**  
**short head**

**Triceps brachii m., medial head**

**Brachialis m.**

**Brachioradialis m.**

**Left Arm,  
Anterior View**

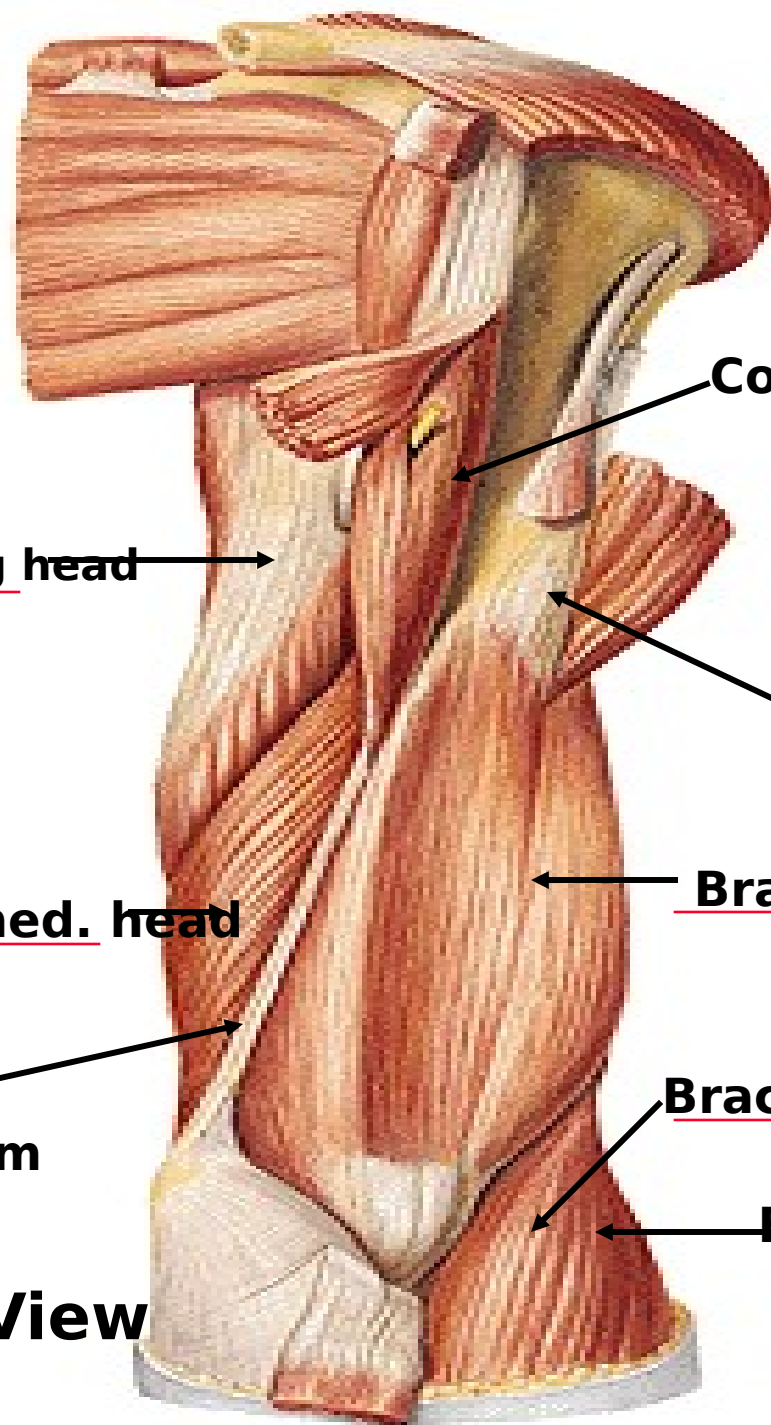
**Extensor carpi radialis  
longus m.**

Triceps brachii m., long head

Triceps brachii m., med. head

medial brachial  
intermuscular septum

**Left Arm, Ant. View**  
**Deep layers**



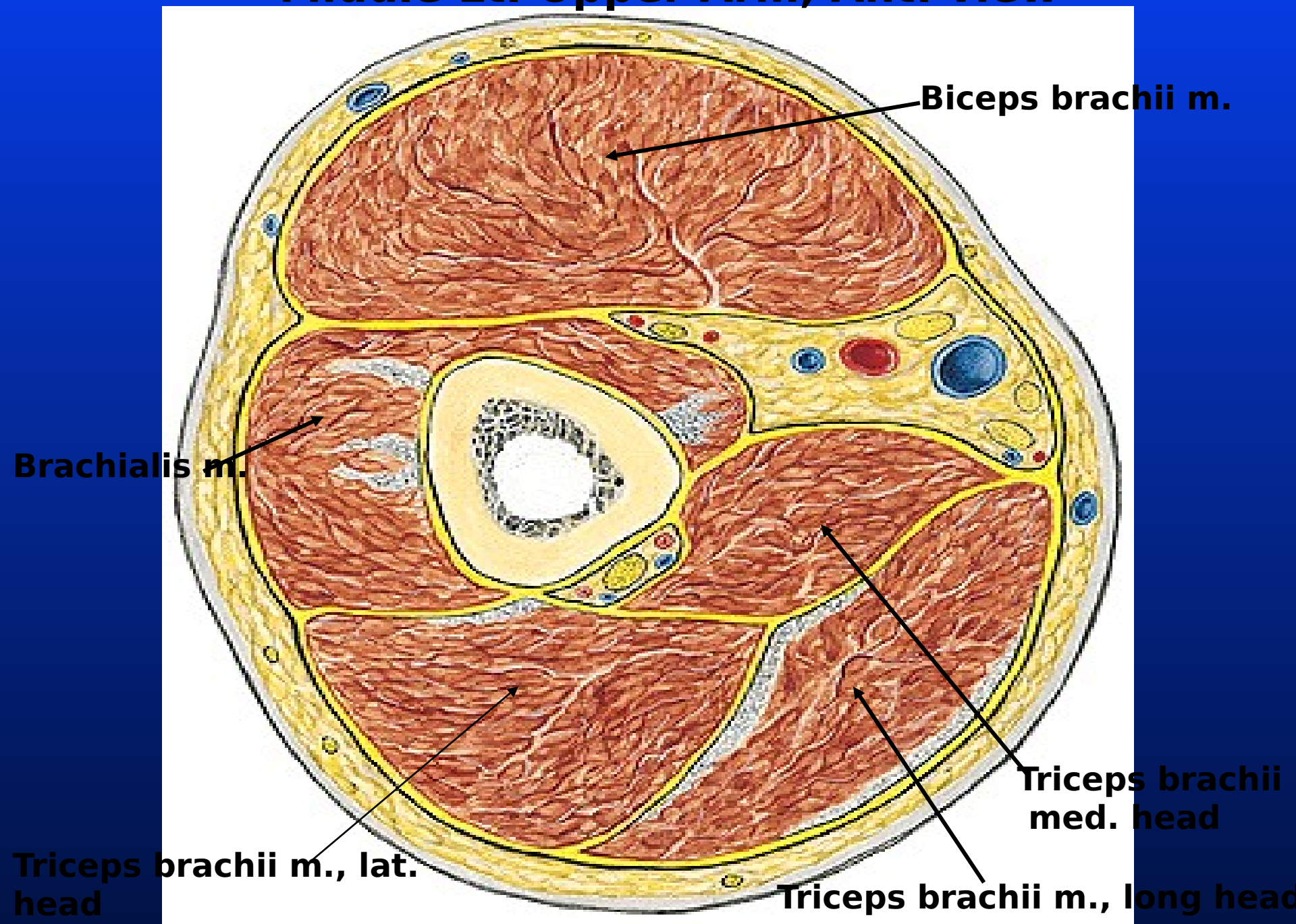
**Coracobrachialis m.**

**Brachialis m.; O = Delto**

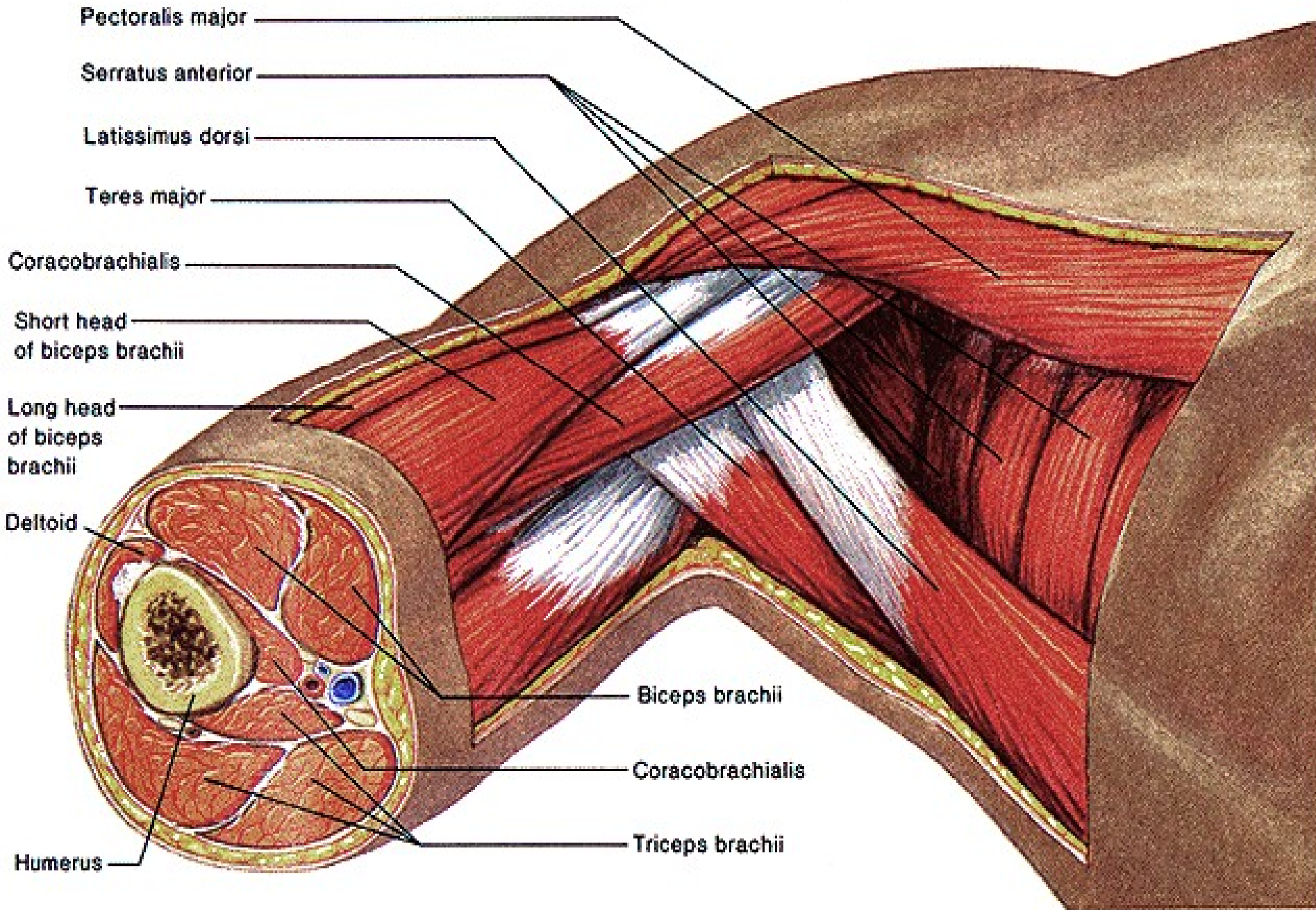
**Brachioradialis m.**

**Extensor carpi radialis  
longus m. (forearm)**

# Middle Lt. Upper Arm, Ant. view

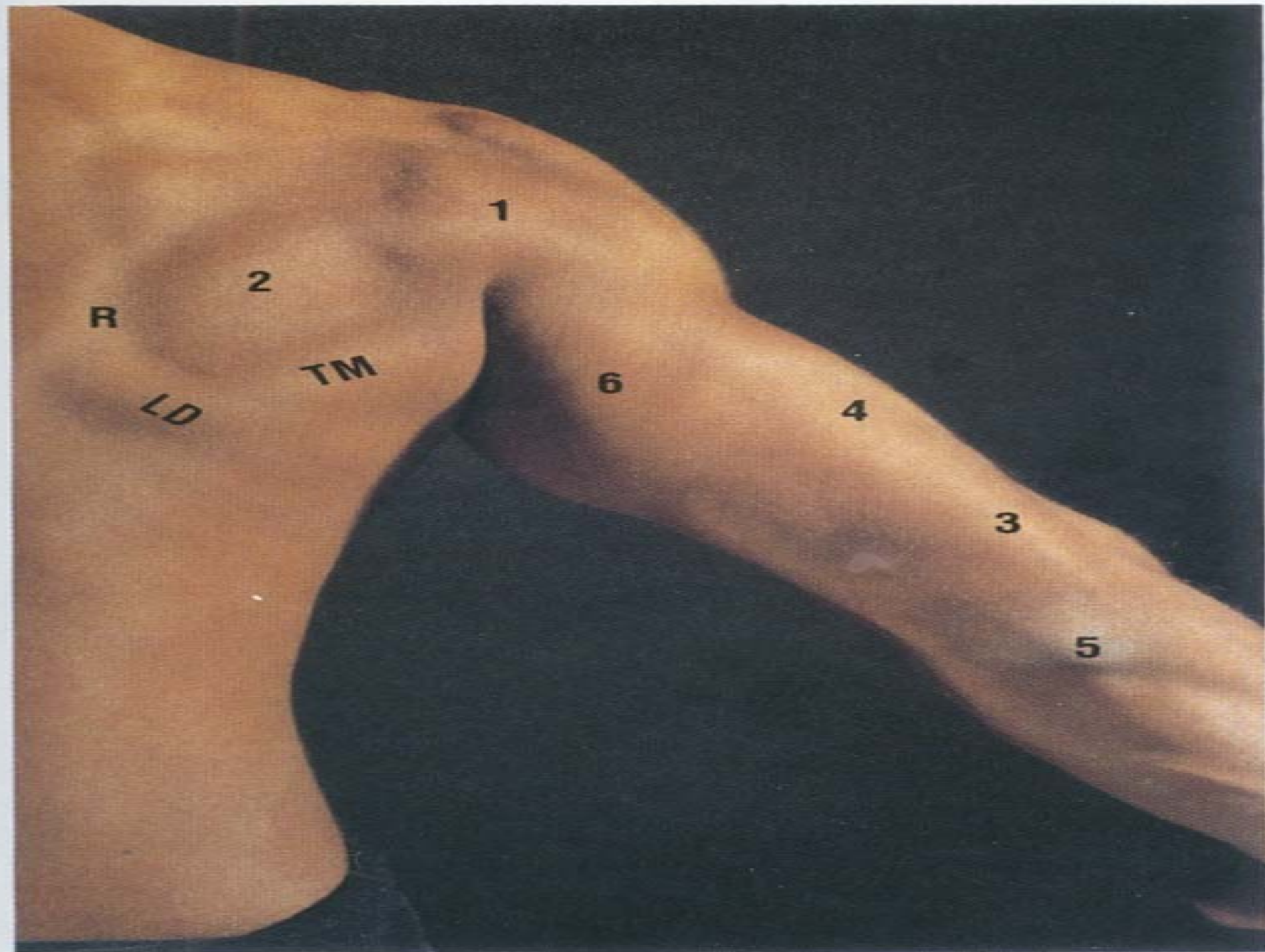


# Cross Section of the Arm.

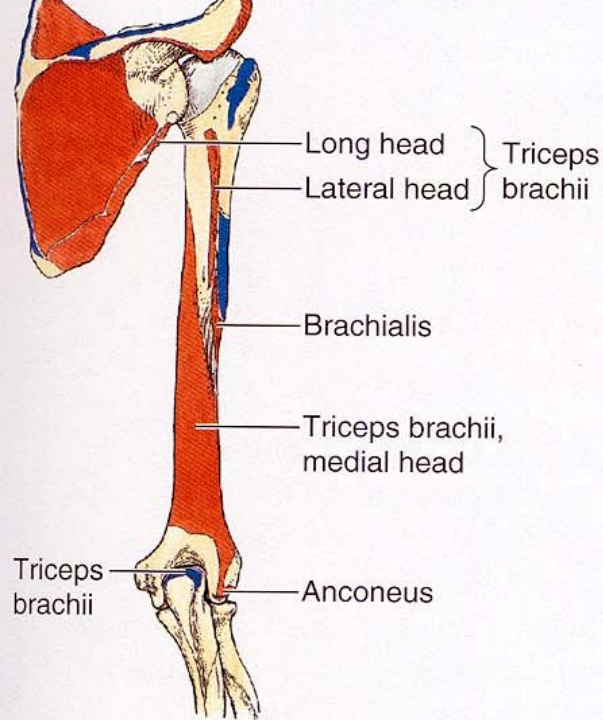


# **Flexors of the Forearm**

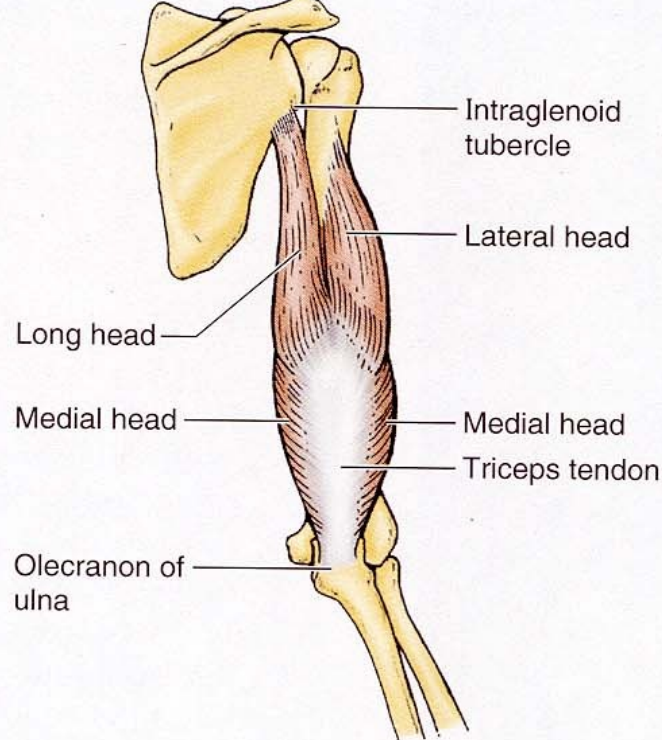
- ***Posterior Extensors***
  - **Triceps brachii**
  - **Anconeus**



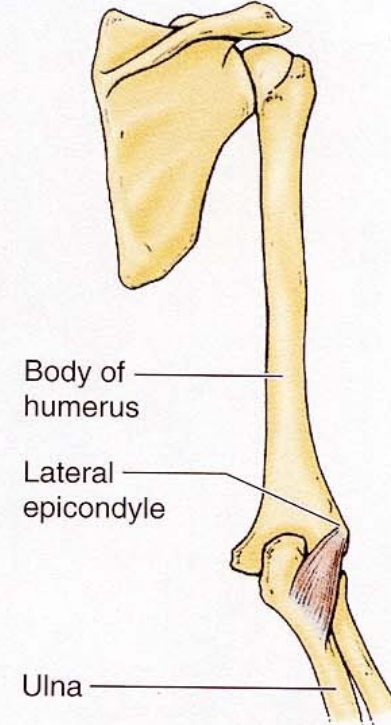




Posterior views



Triceps brachii

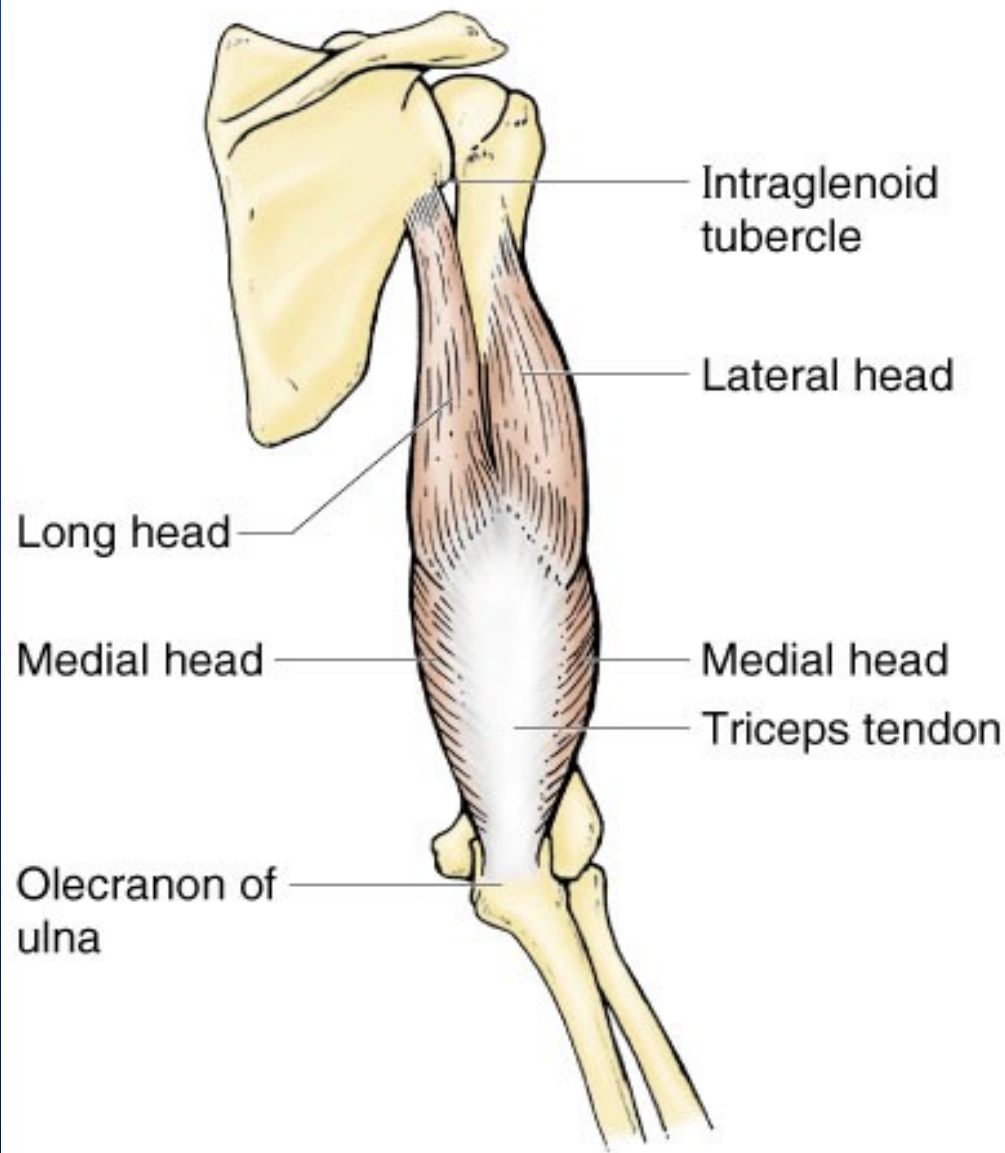


Anconeus

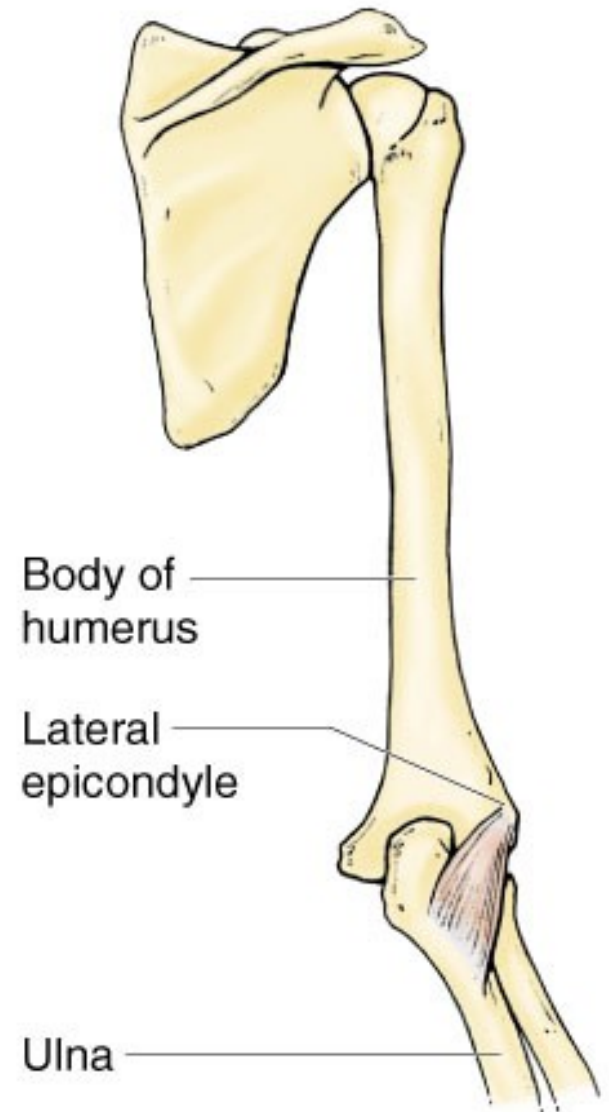
Muscle	Proximal Attachment	Distal Attachment	Innervation <sup>a</sup>	Main Action
Triceps brachii	Long head: infraglenoid tubercle of scapula Lateral head: posterior surface of humerus, superior to radial groove Medial head: posterior surface of humerus, inferior to radial groove	Proximal end of olecranon of ulna and fascia of forearm	Radial nerve (C6, <b>C7</b> , and <b>C8</b> )	Extends the forearm; it is chief extensor of forearm; long head steadies head of abducted humerus
Anconeus	Lateral epicondyle of humerus	Lateral surface of olecranon and superior part of posterior surface of ulna	Radial nerve (C7, C8, and T1)	Assists triceps in extending forearm; stabilizes elbow joint; abducts ulna during pronation



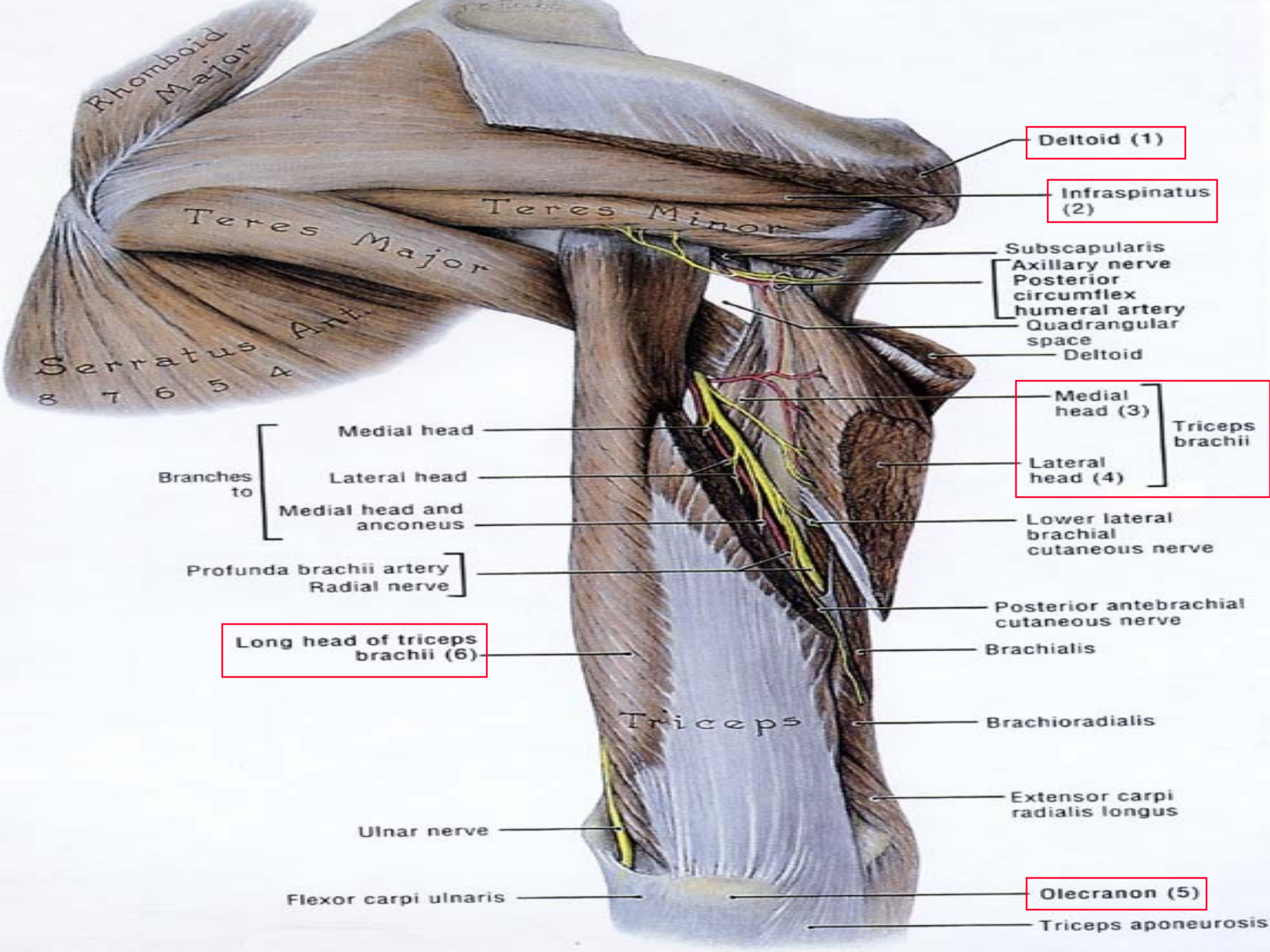
**Table 6.5.** (Continued) **Muscles of the Arm**



**Triceps brachii**

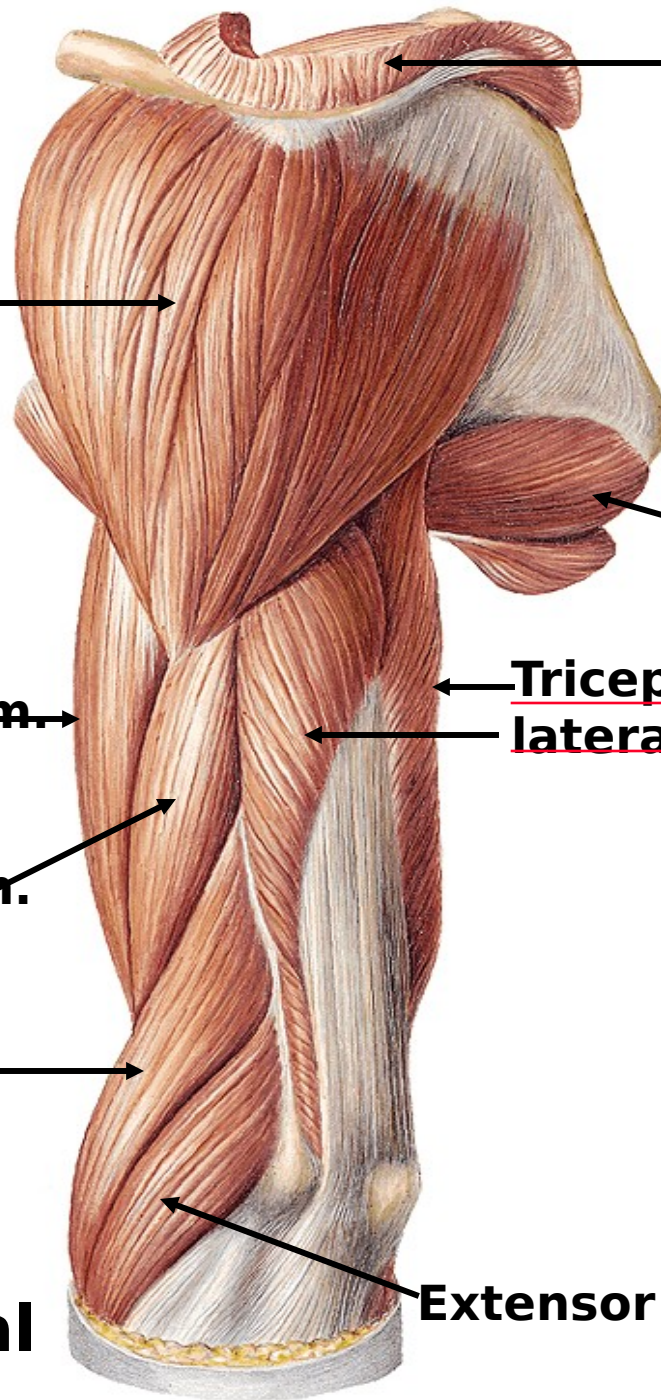


**Anconeus**





**Left Shoulder,  
Posterior Lateral**



**Trapezius m.**

**Deltoid m.**

**Teres major m.**

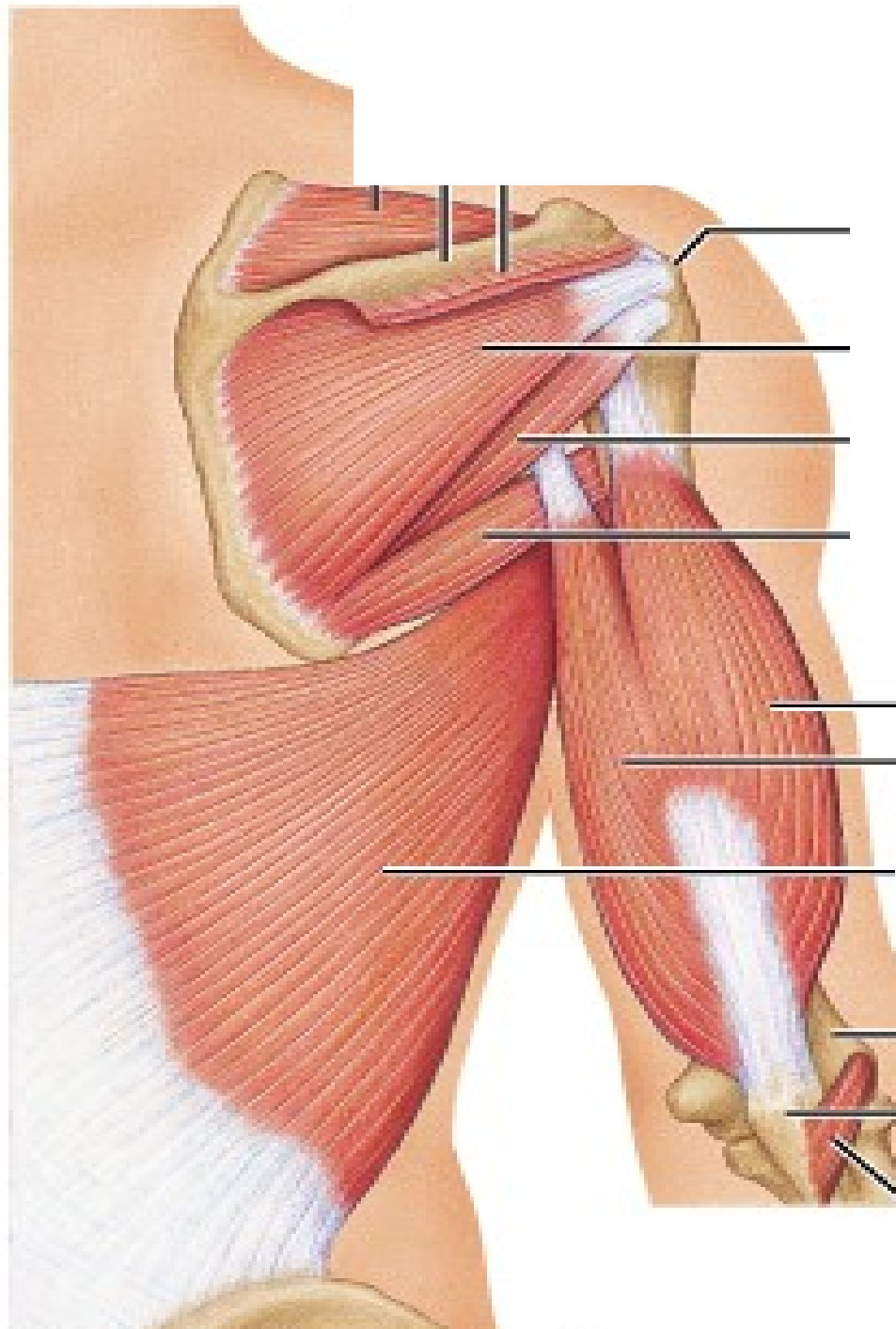
**Biceps brachii m.**

**Triceps brachii m., long head  
lateral head**

**Brachialis m.**

**Brachioradialis m.**

**Extensor carpi radialis longus m.**



## Posterior Extensors Rt. Post. view

Triceps brachii:

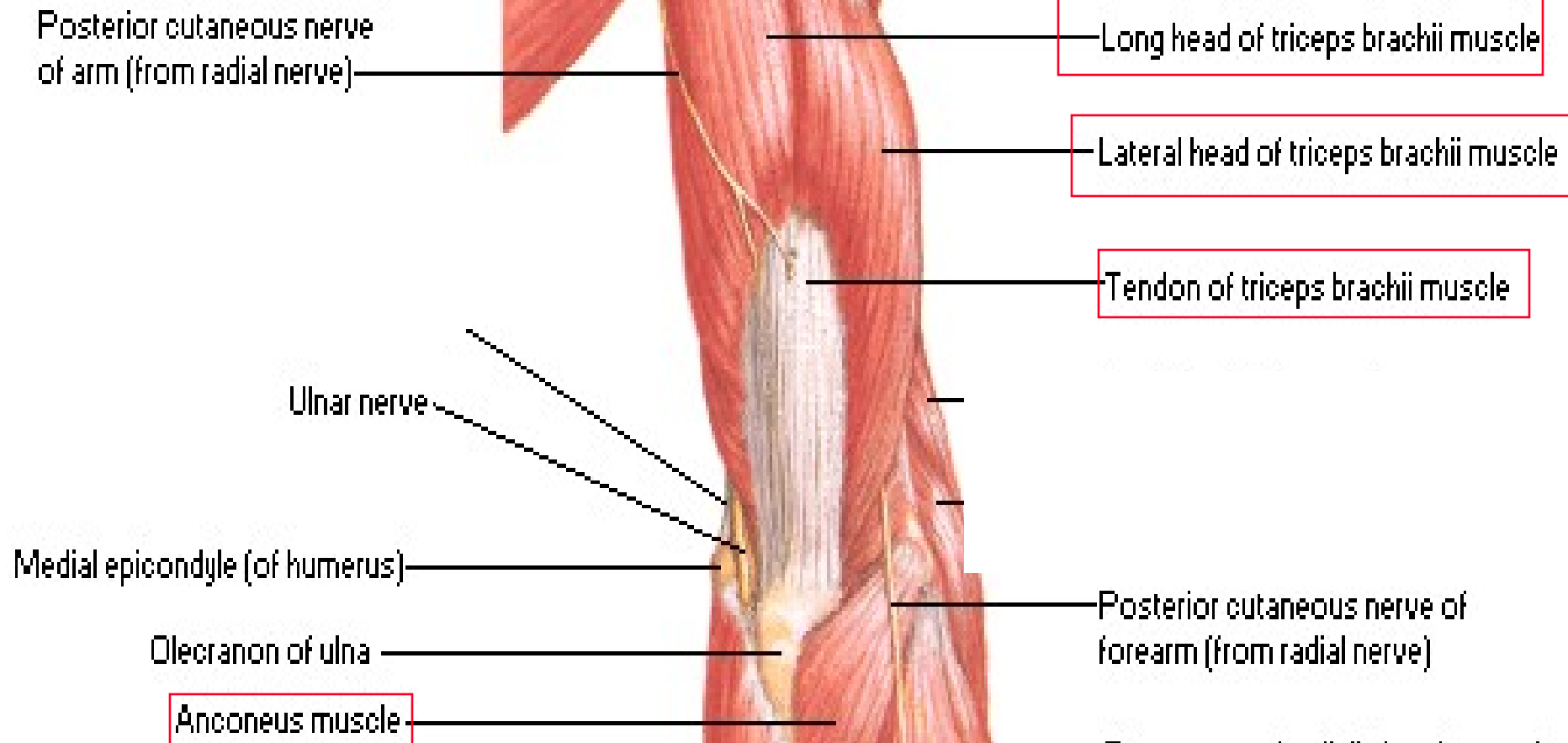
- Lateral head
- Long head

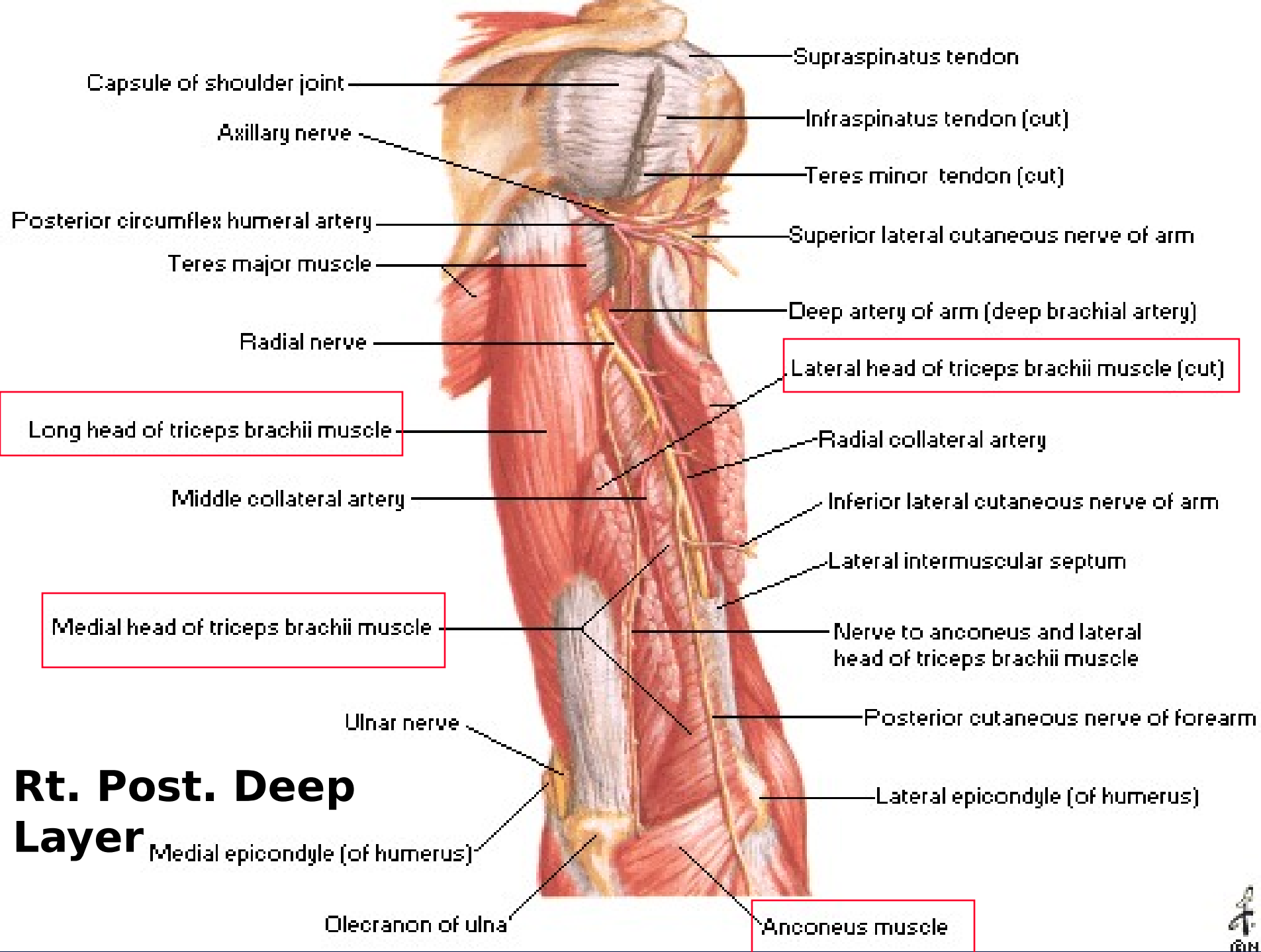
Humerus

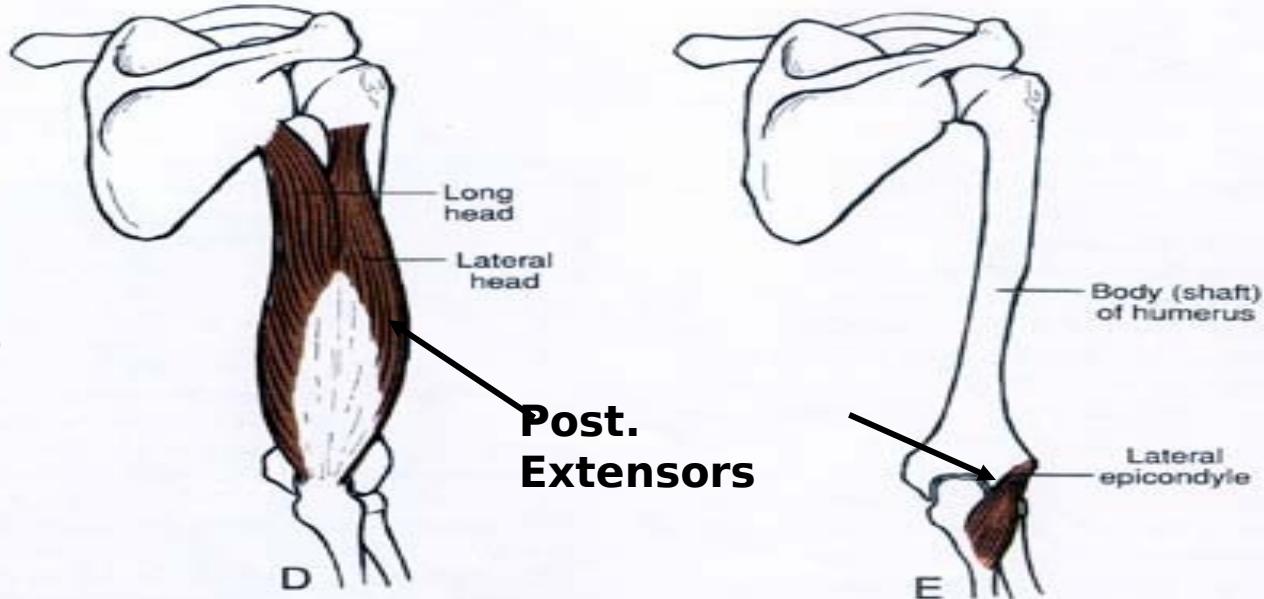
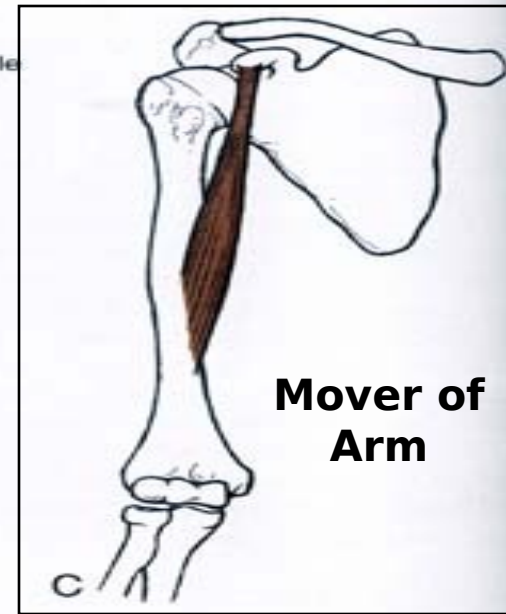
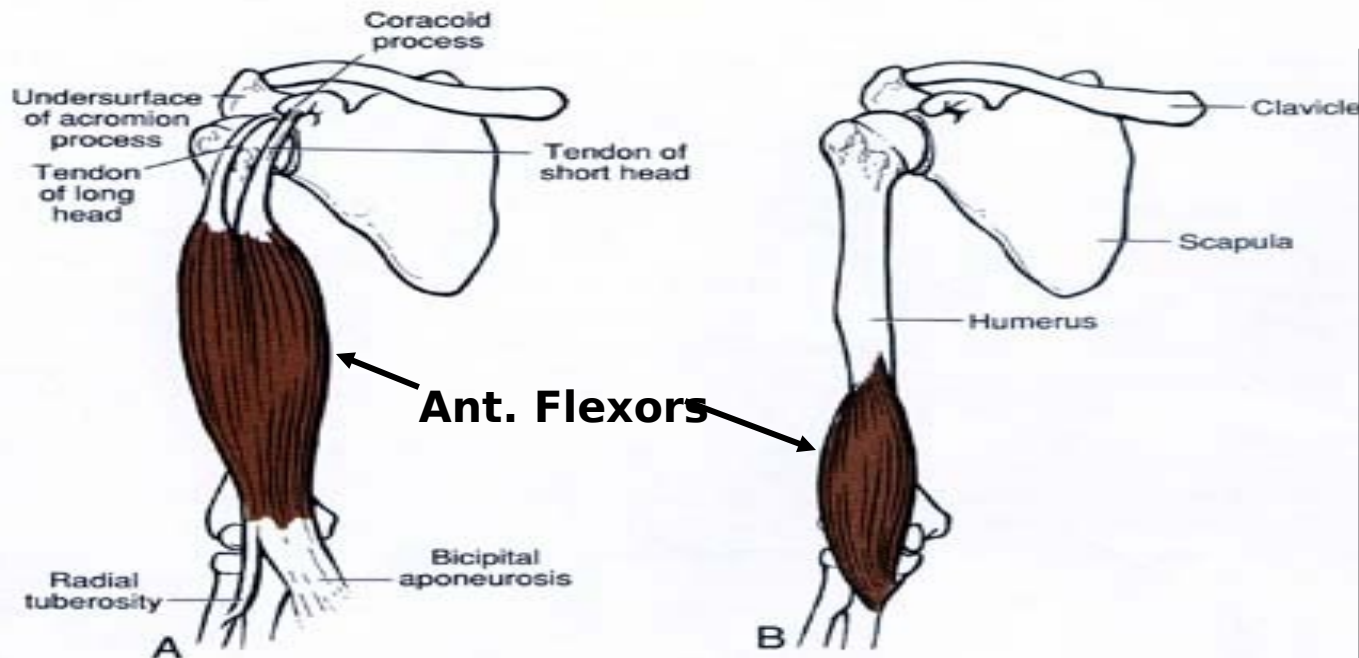
Olecranon process  
of ulna

Anconeus

## Rt. Superficial Posterior Extensors







**Figure 6-51.** Muscles of the arm. *A*, Biceps brachii, *B*, Brachialis, *C*, Coracobrachialis, *D*, Triceps brachii. The medial head is not shown. It is attached to the deep surface of the triceps tendon. *E*, Anconeus.

**Movers of the Forearm**

# THE AXILLA

- The axilla contains
  - Large nerves that are the branches of the ***brachial plexus***
  - The ***axillary vessels*** – axillary artery & vein
  - The ***axillary lymph nodes***





## Surface Anatomy: Axillary Lymph Nodes

Lateral  
Axillary  
Central  
Axillary  
Subscapular  
Pectoral

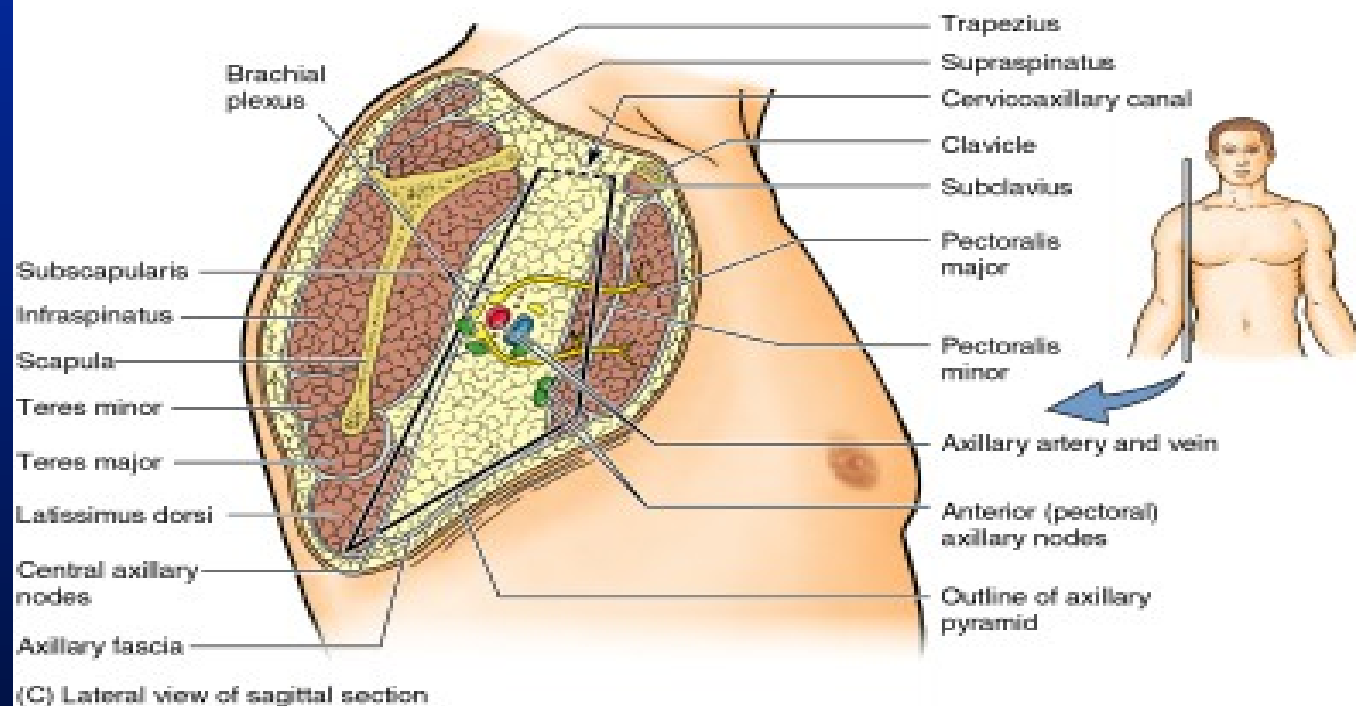
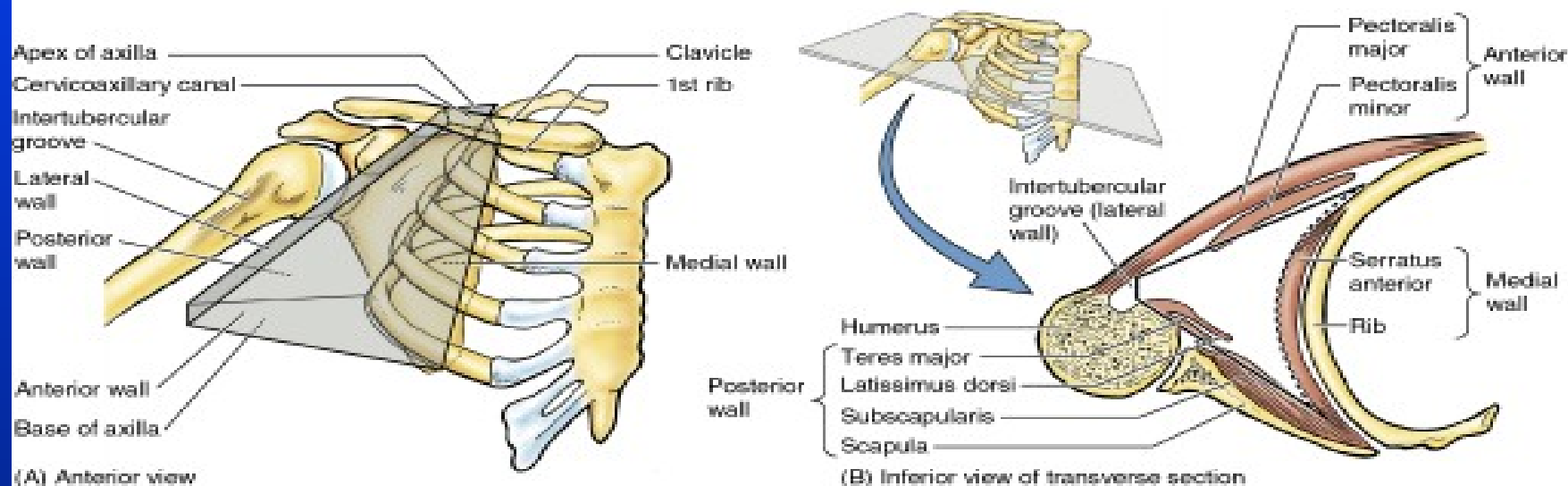


Roll mouse over image to display axillary lymph node regions.  
Note the central axillary nodes lie deep within the axilla.

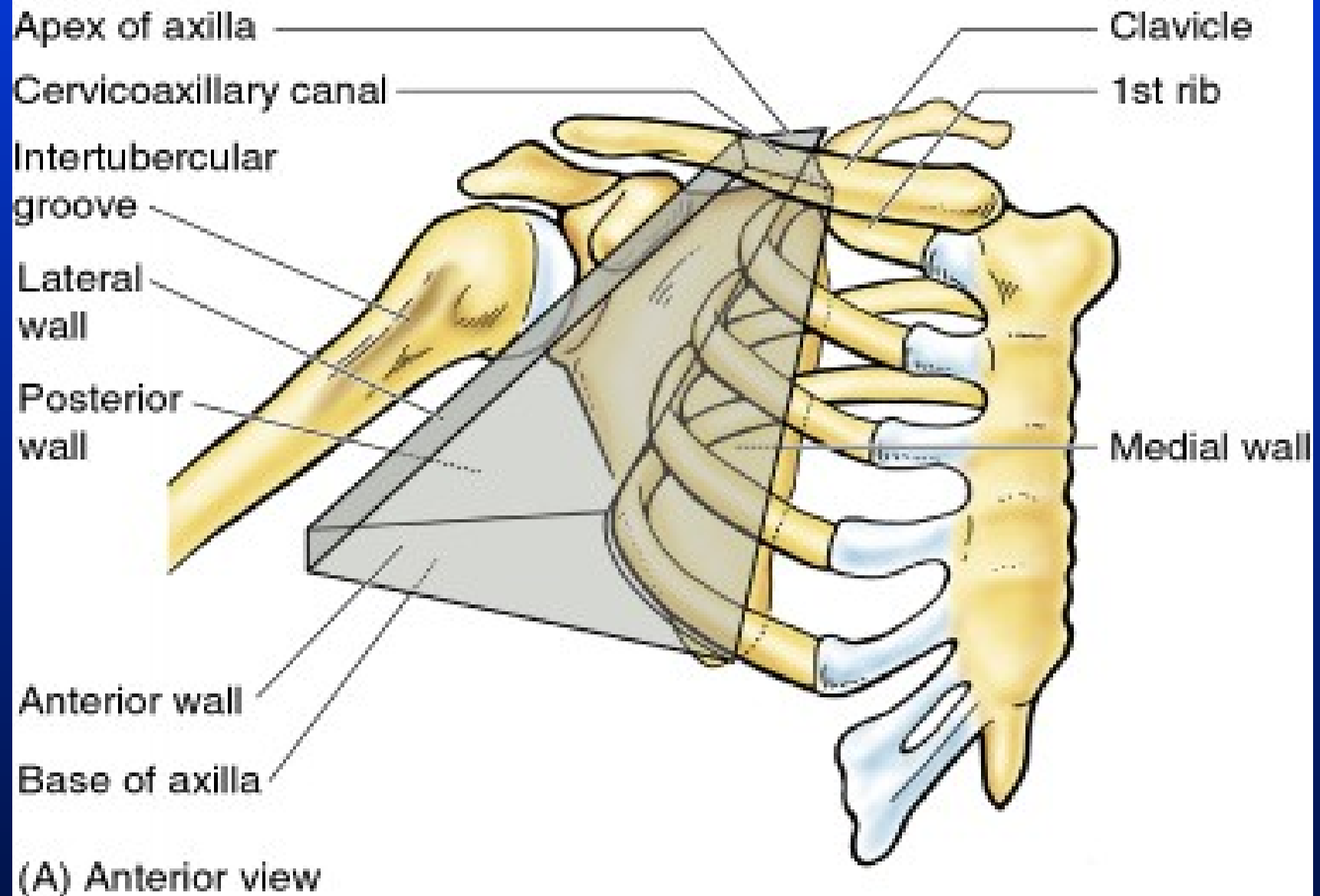




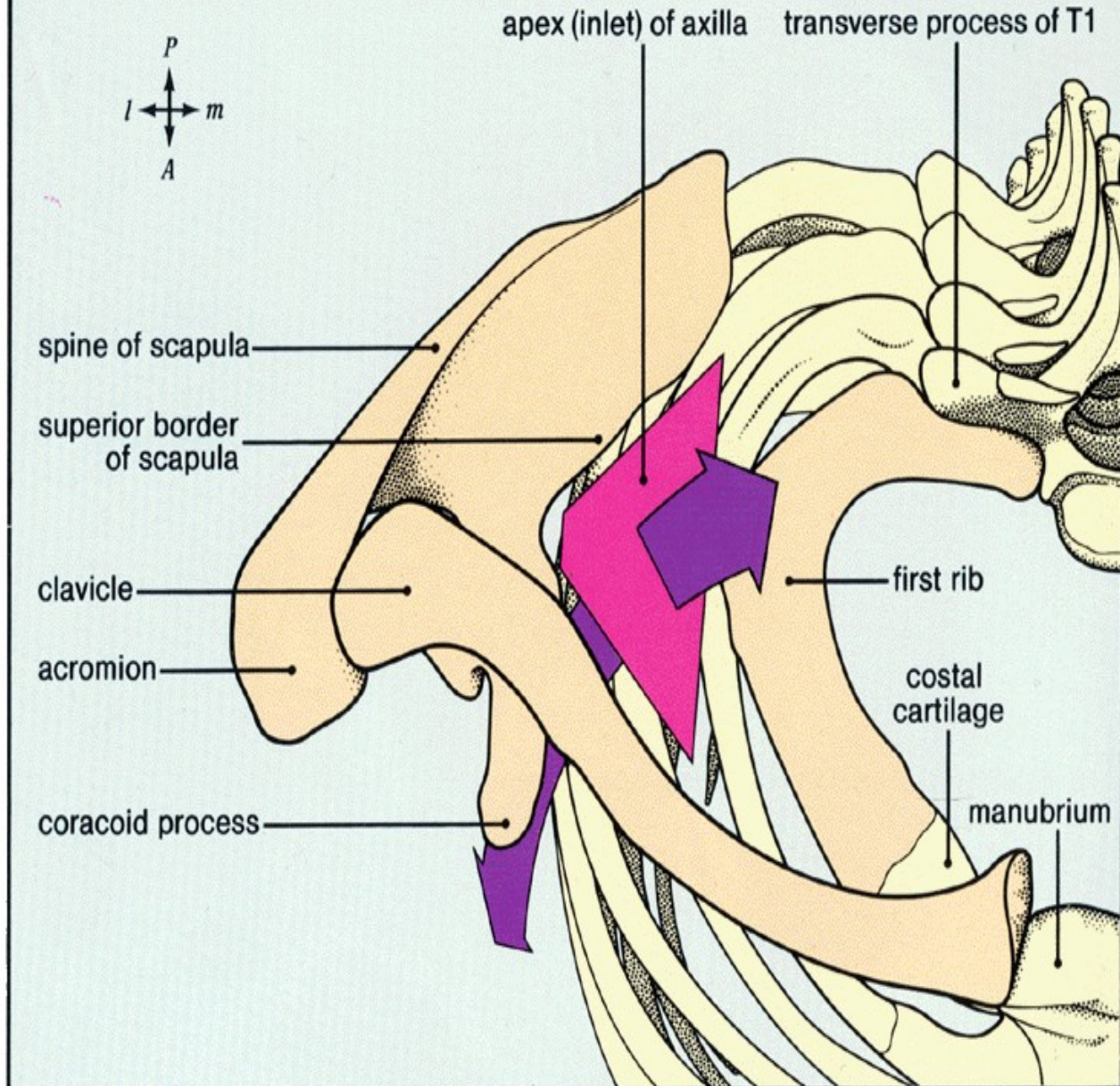
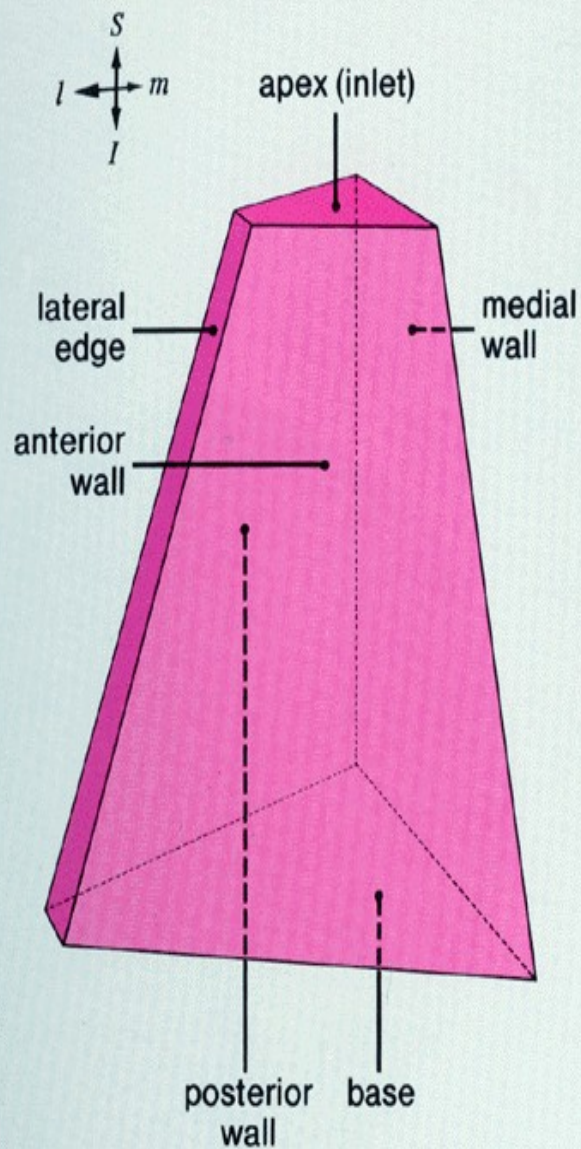
6.23A. Axilla: anterior view demonstrating pyramidal space. B, Axilla: transverse section, inferior view. C, Axilla: sagittal section, lateral view.



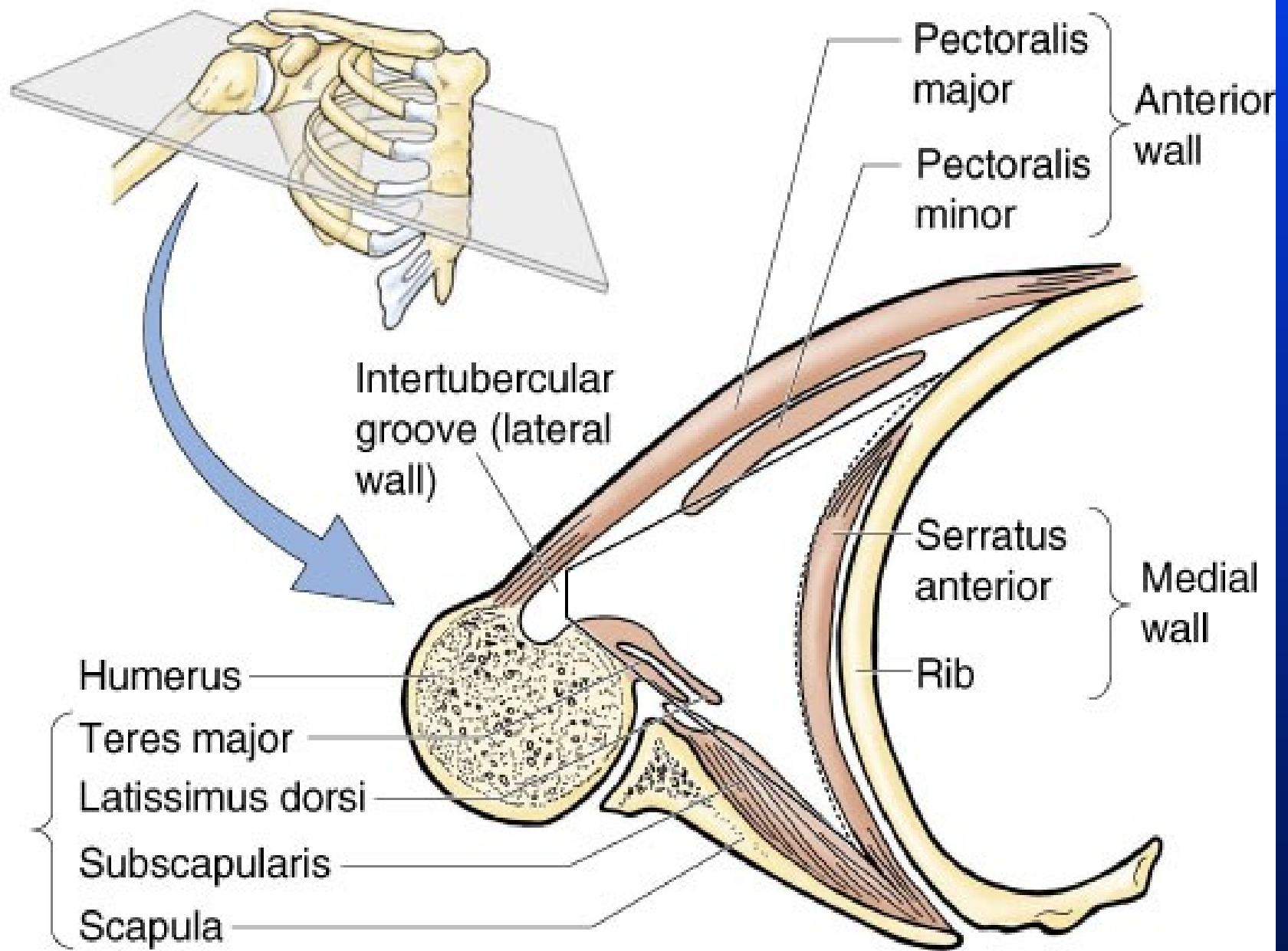
6.23A. Axilla: anterior view demonstrating pyramidal space.







6.23B, Axilla: transverse section, inferior view.



(B) Inferior view of transverse section

Pectoralis major

Pectoralis minor

Intertubercular  
groove

axilla

Humerus

Serratus  
anterior

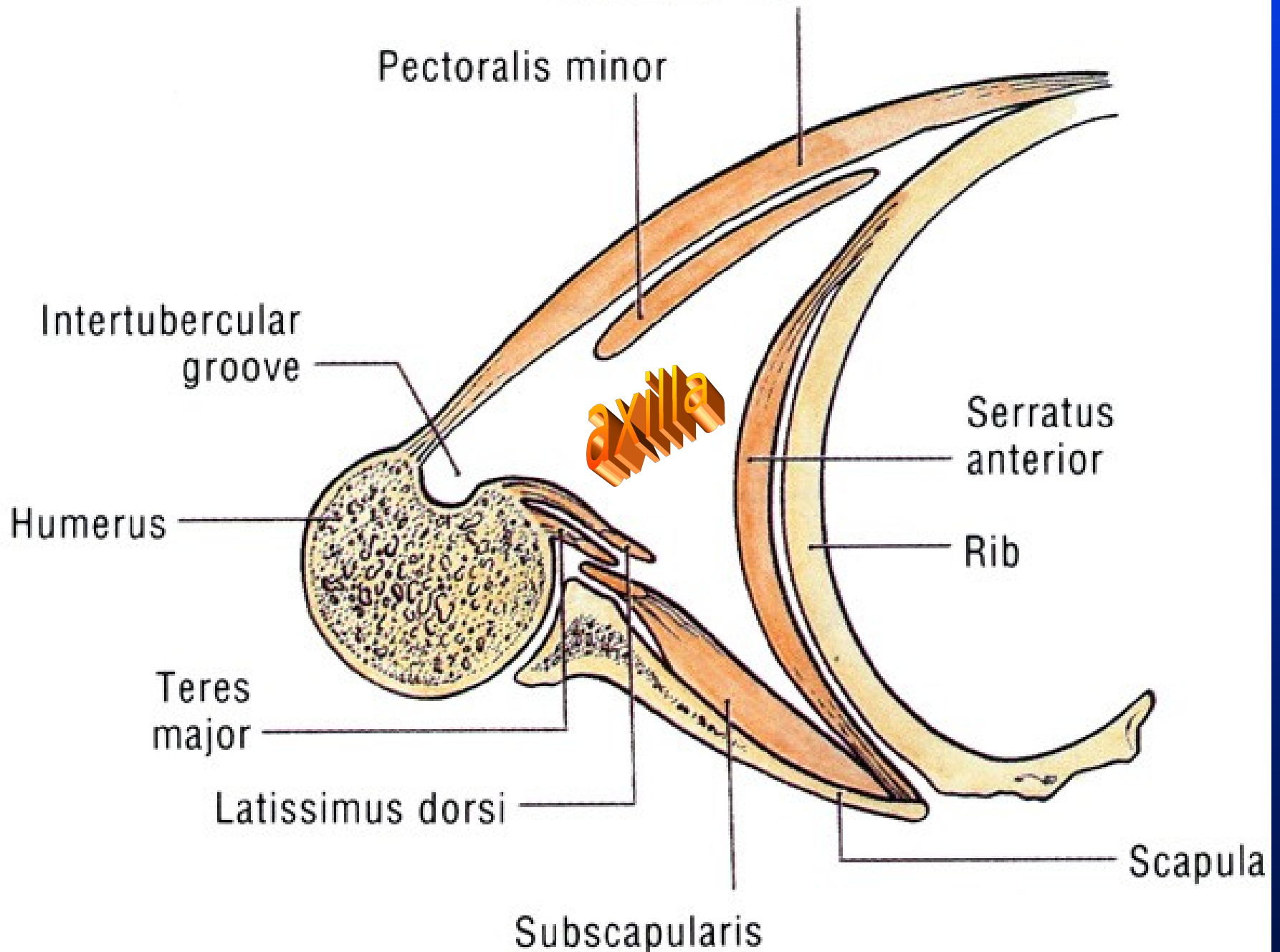
Rib

Teres  
major

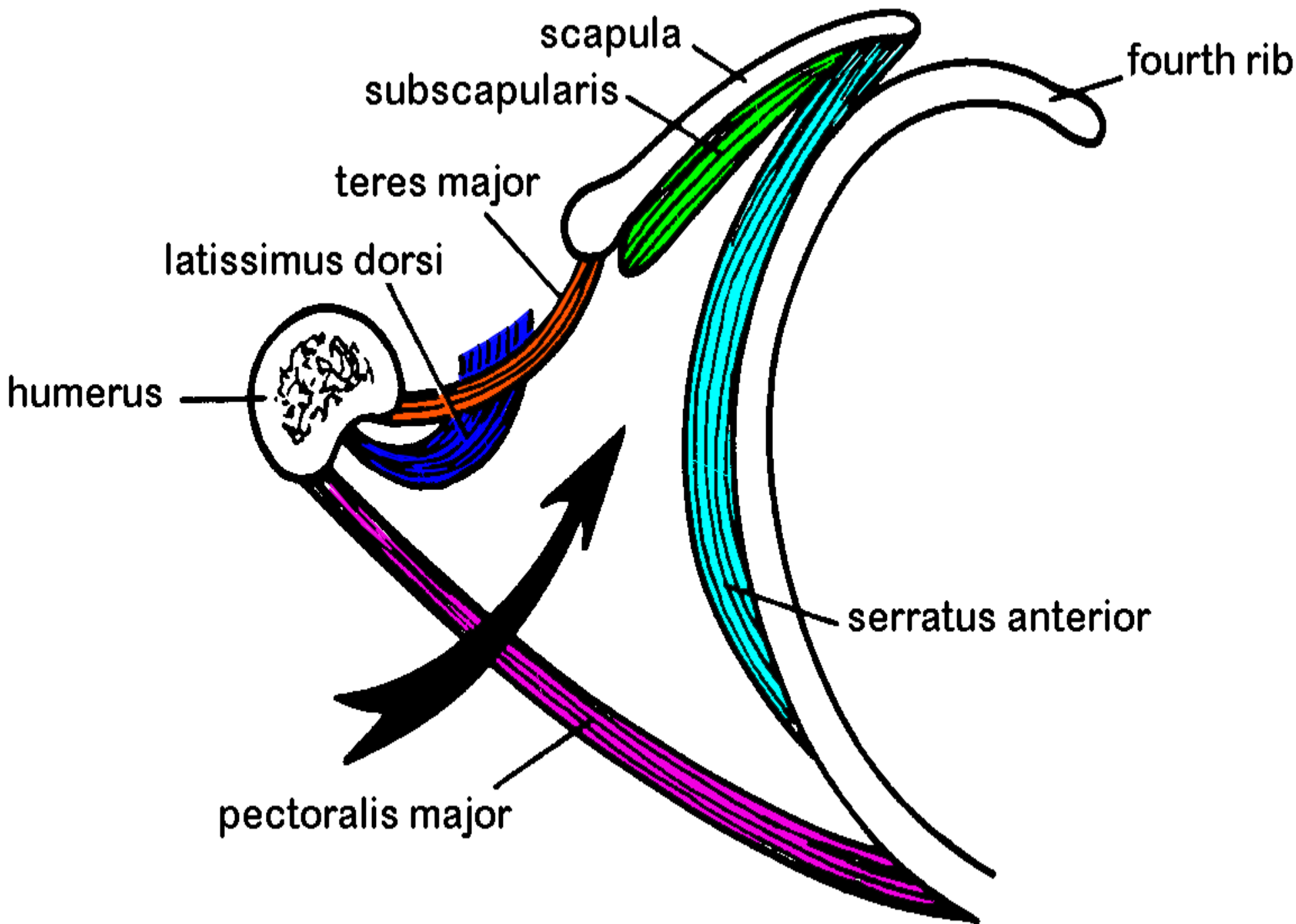
Latissimus dorsi

Scapula

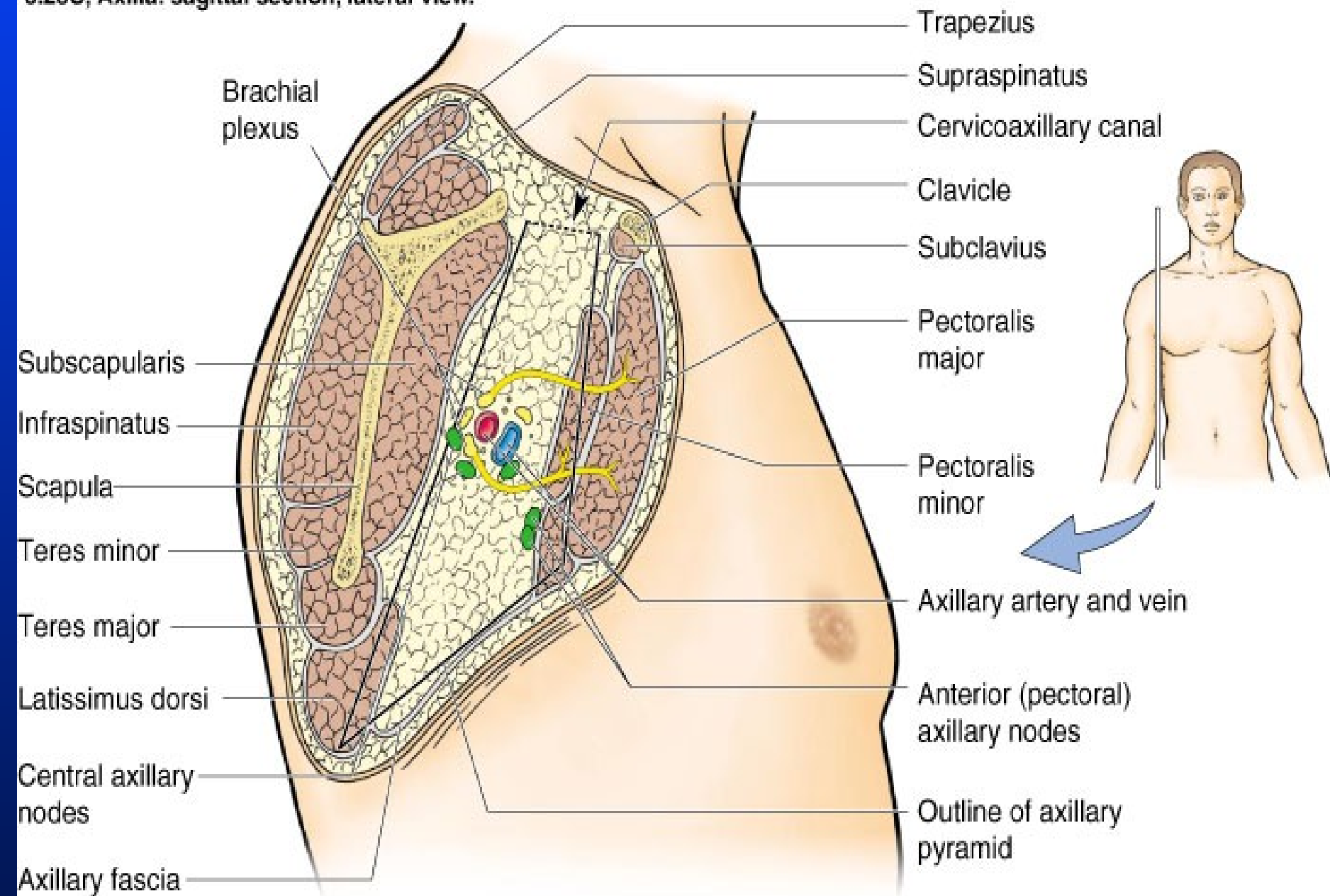
Subscapularis





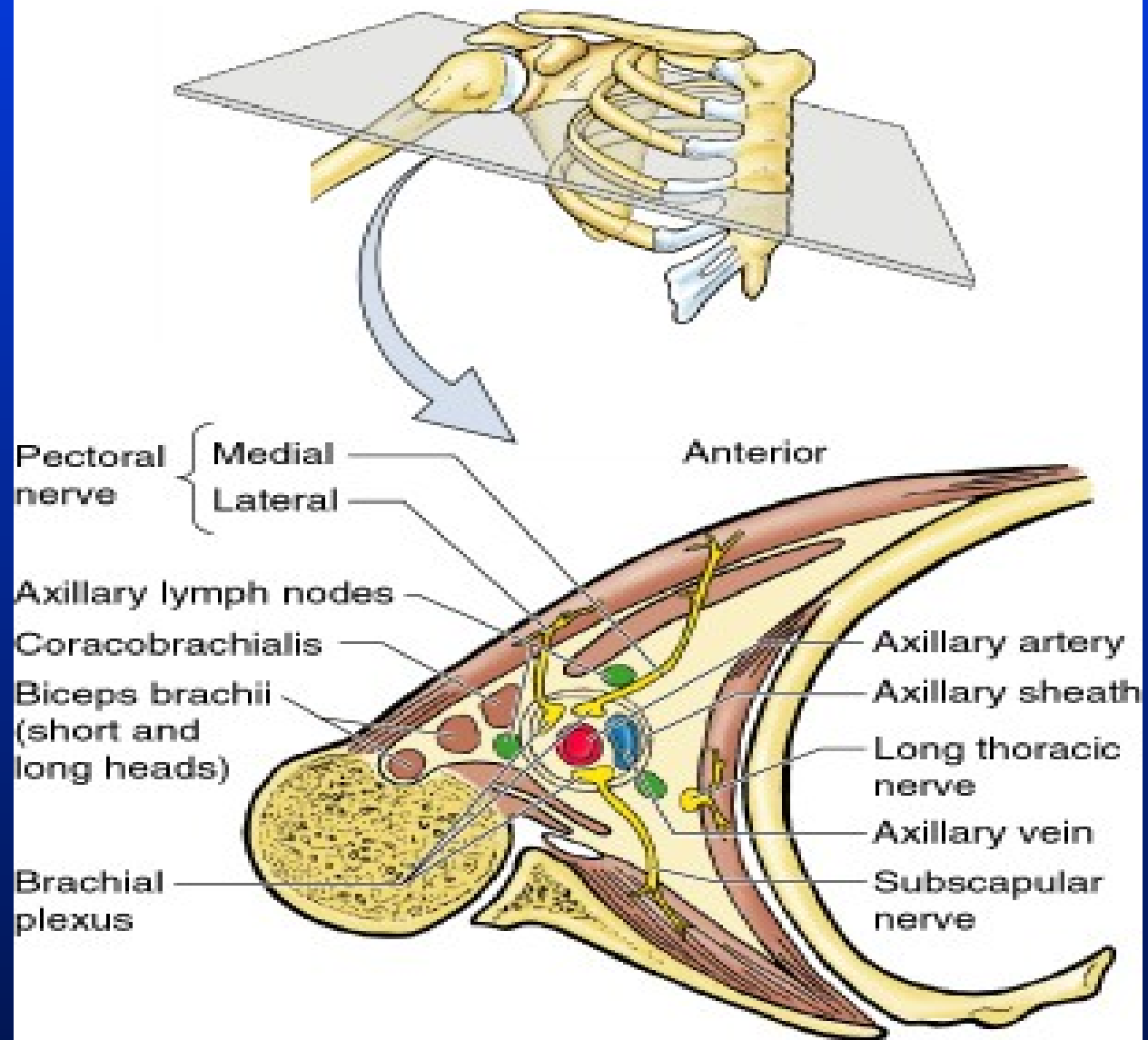


6.23C, Axilla: sagittal section, lateral view.



(C) Lateral view of sagittal section

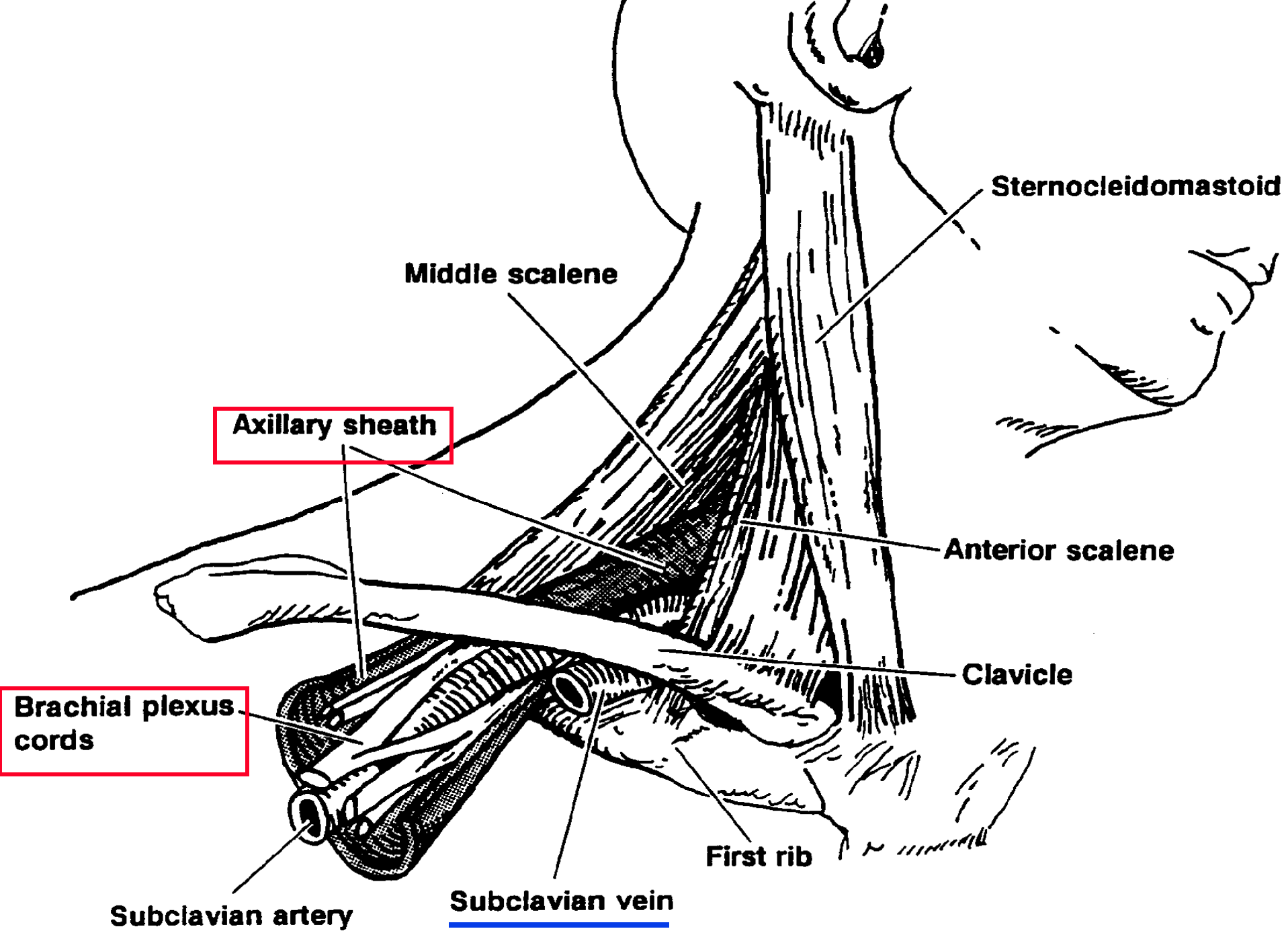
6.24A. Neurovascular structures in the axilla, inferior view of a transverse section.



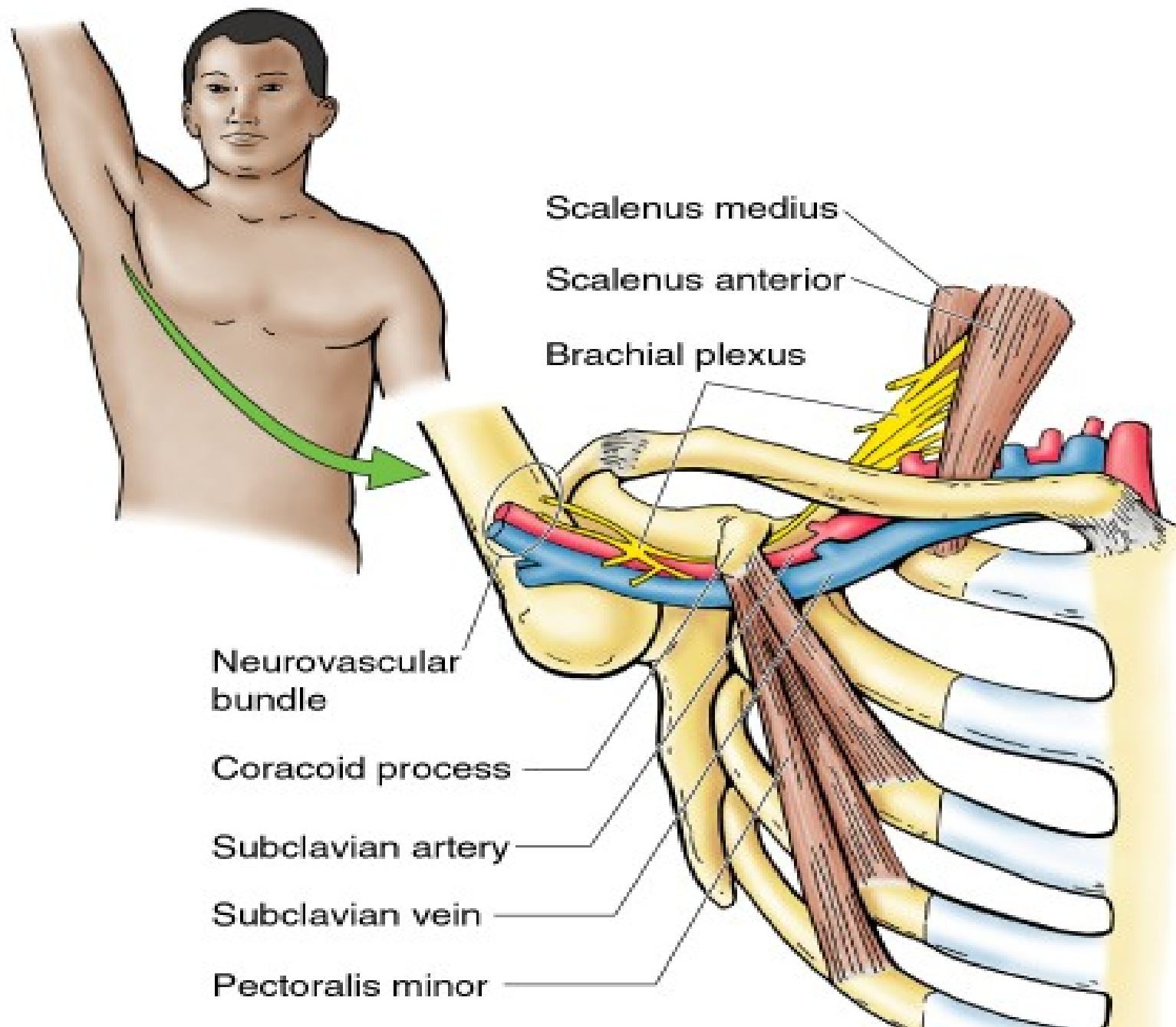
(A) Inferior view of transverse section

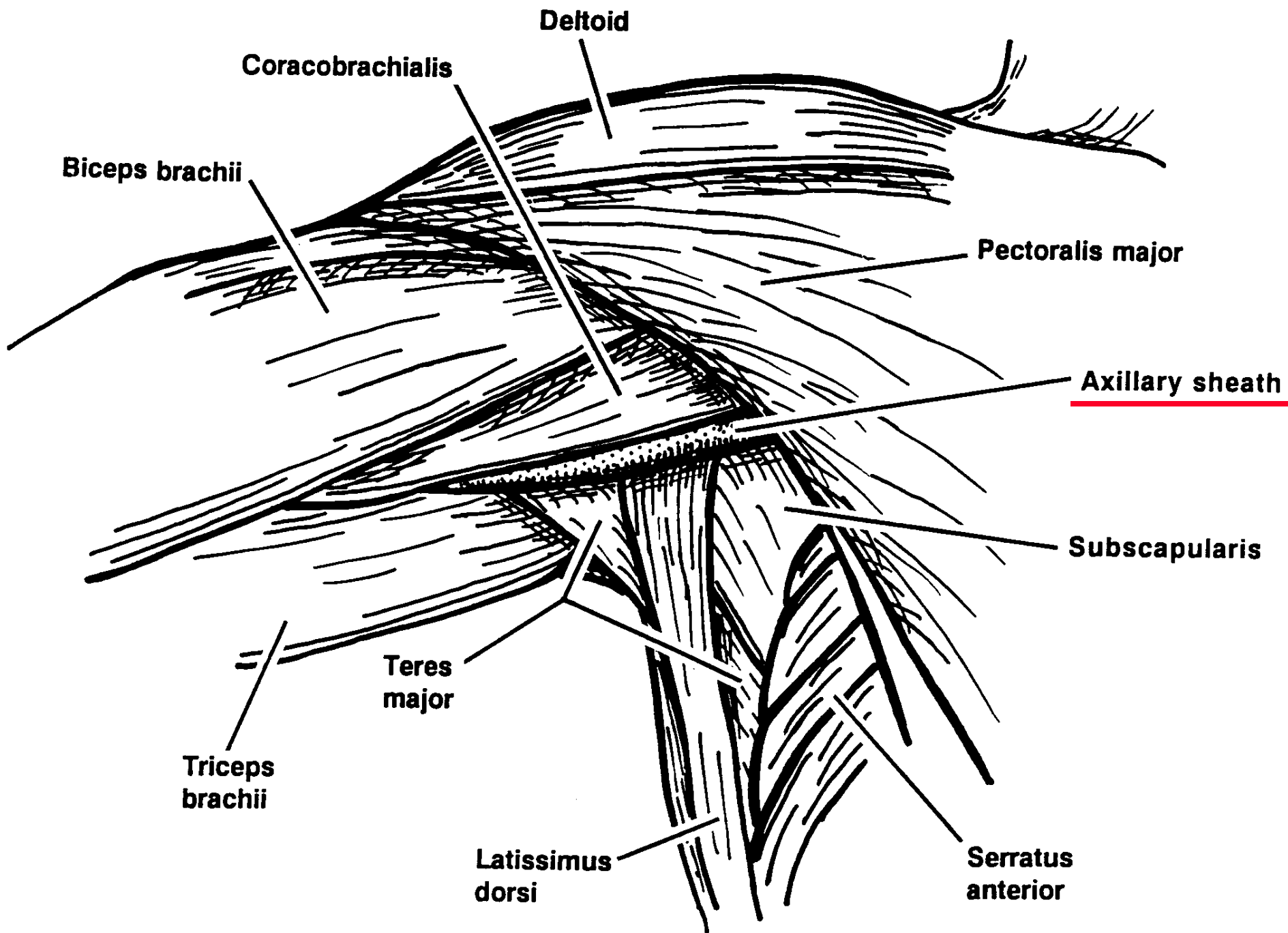
# Axillary

- **Axillary sheath** of the Brachial Plexus contains NAV:
  - **Axillary n**
  - **Ulnar n**
  - **Radial n**
- **Axillary artery & vein**
  - Divided into 3 parts
  - Major branches



6.86. Compression of the neurovascular bundle in the axilla.





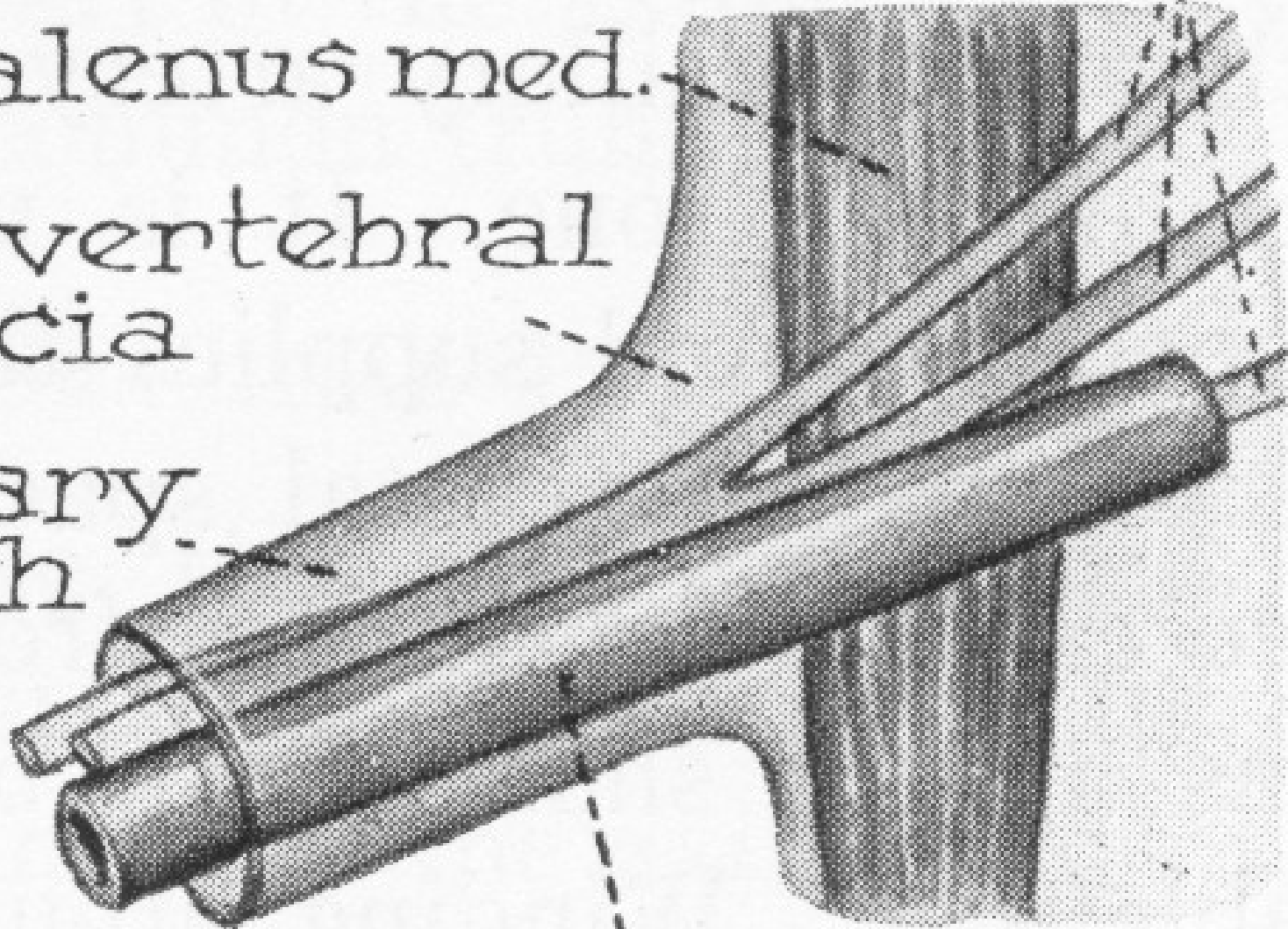
Brachial plexus

Scalenus med.

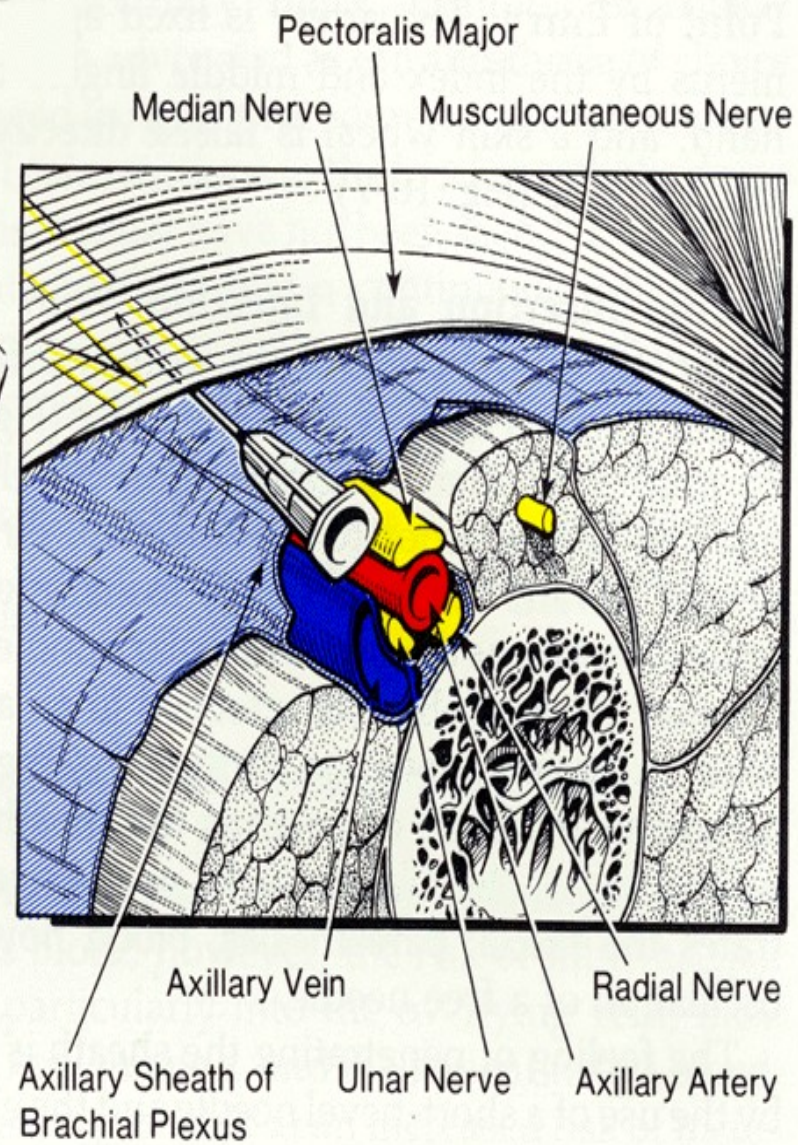
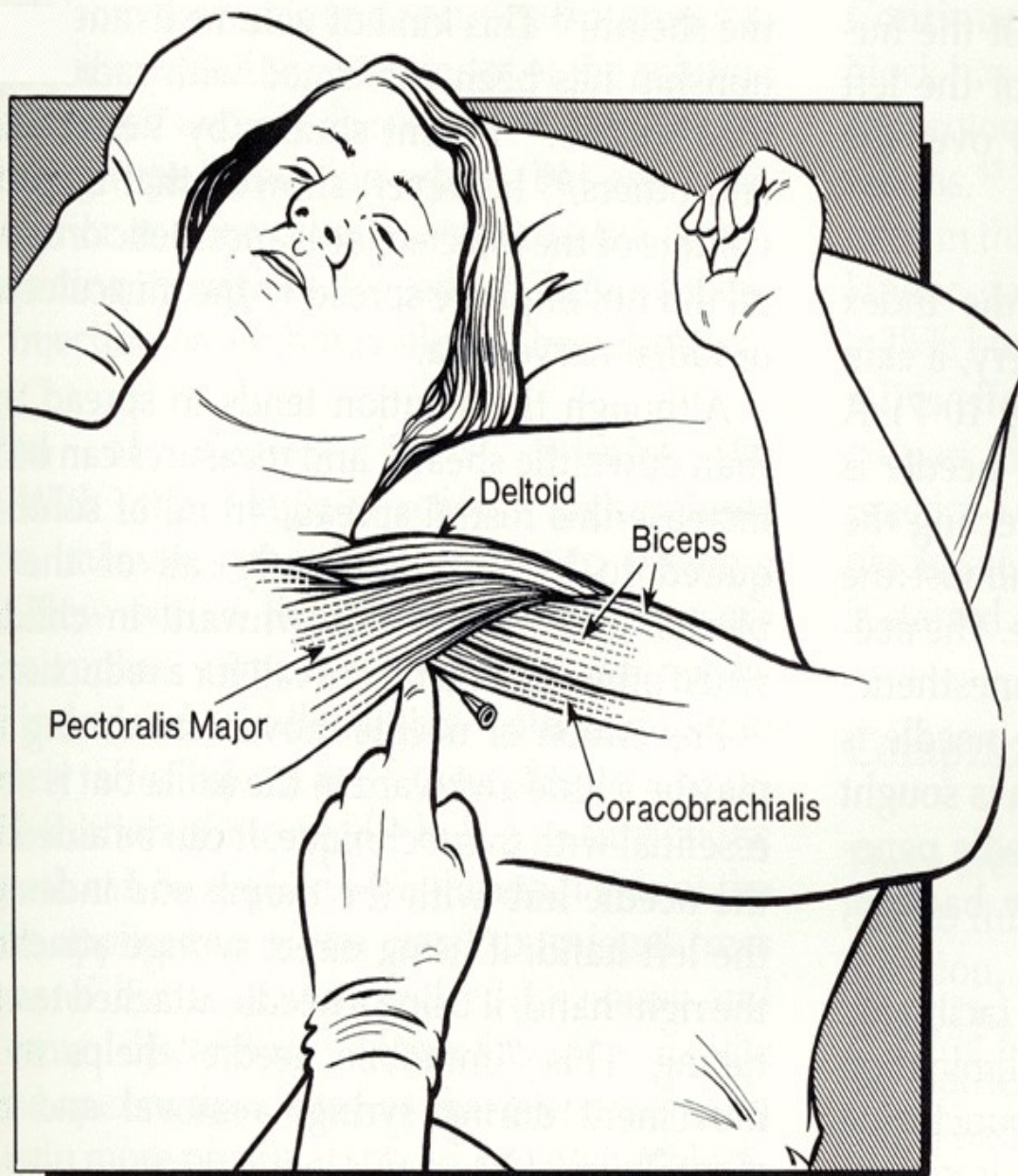
Prevertebral  
fascia

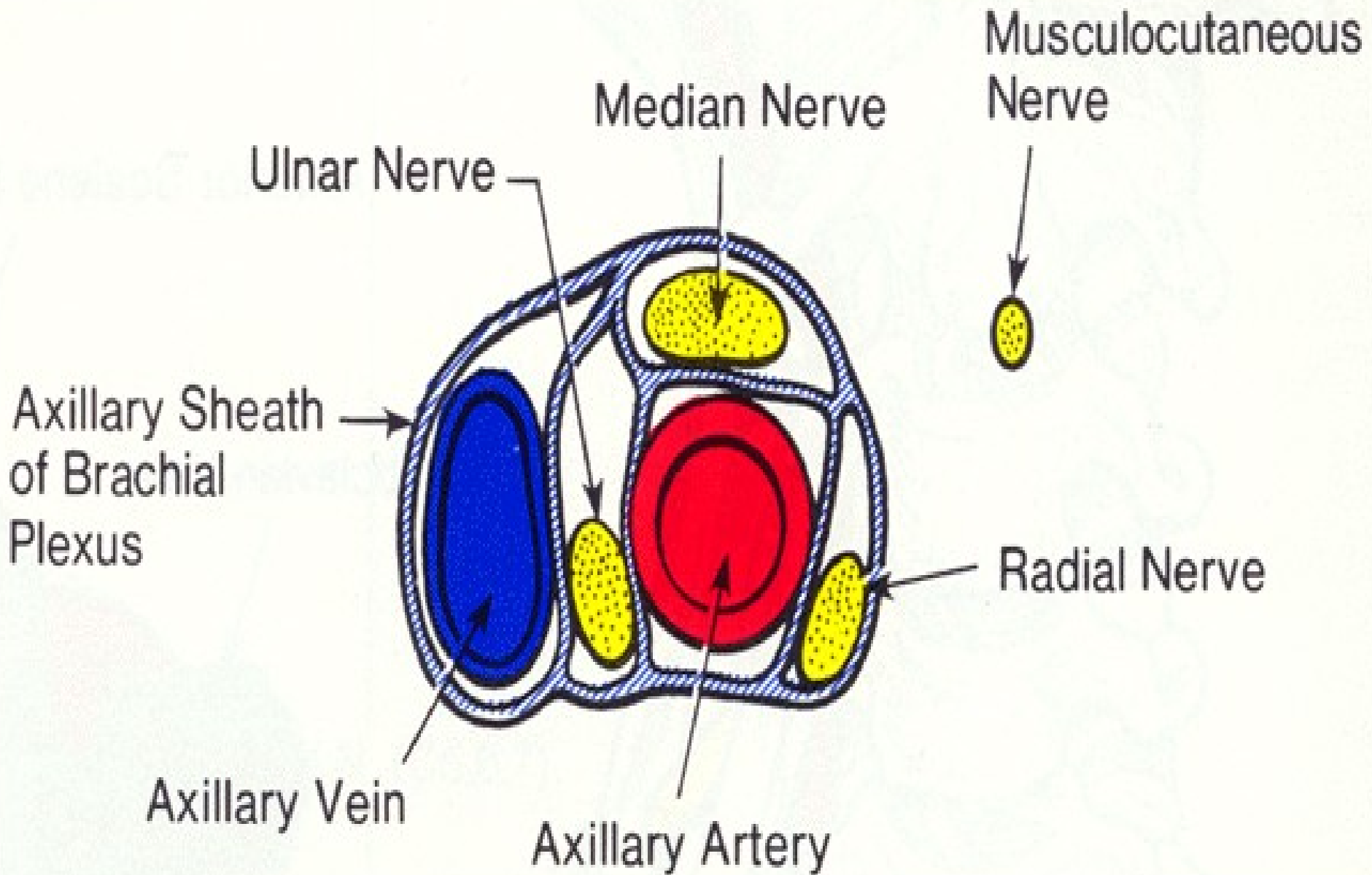
Axillary  
sheath

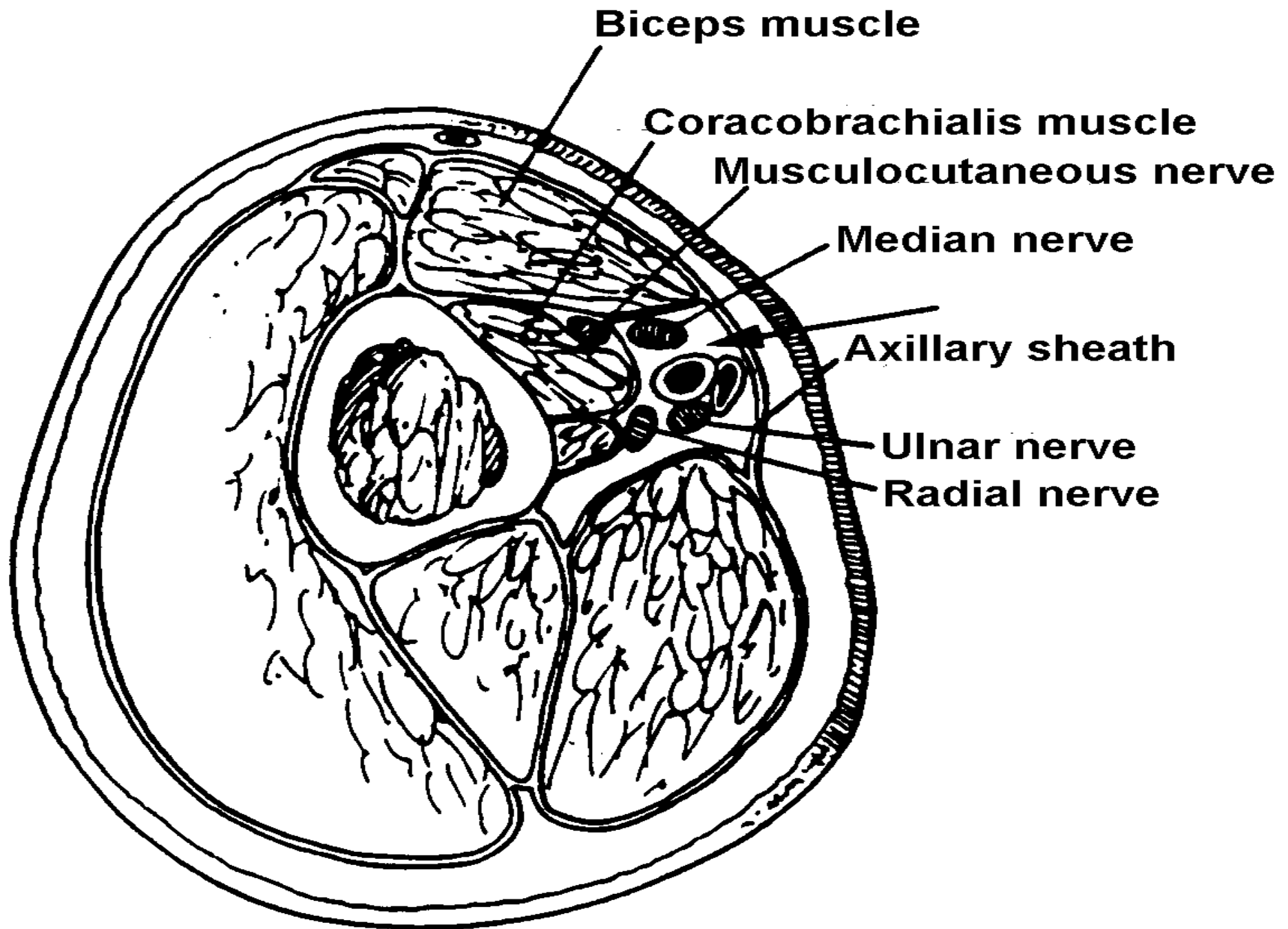
Axillary a.



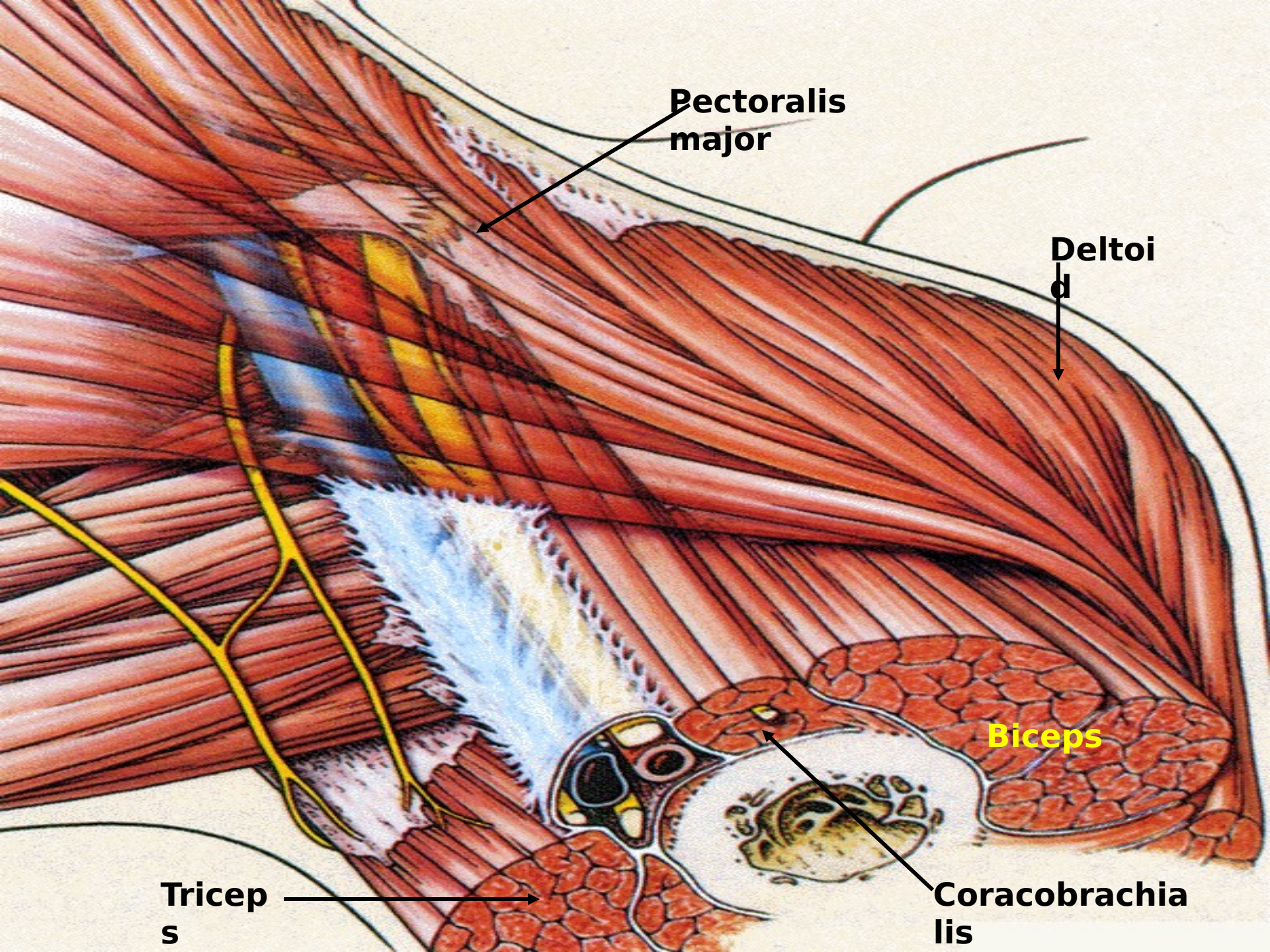












**Pectoralis  
major**

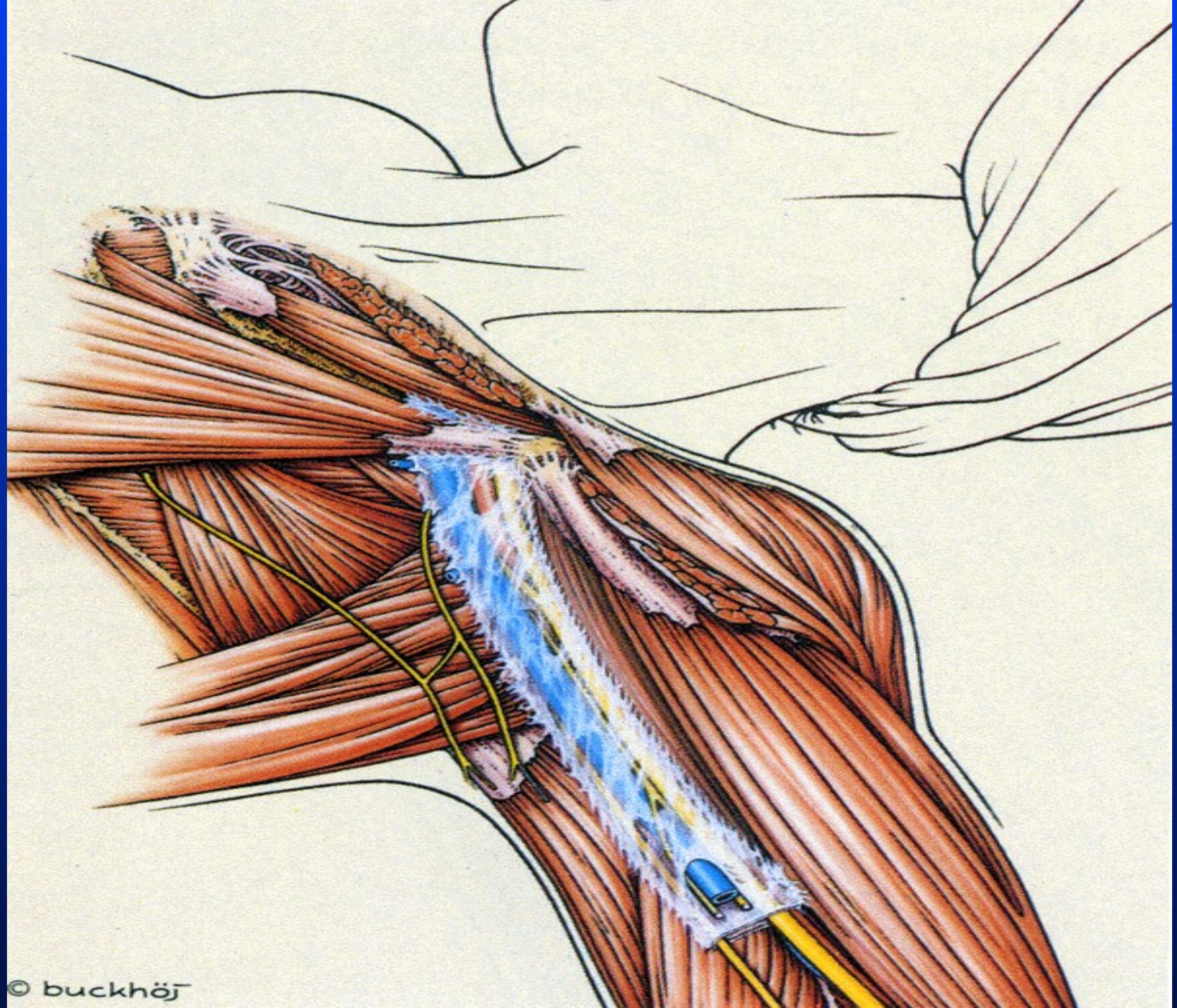
**Deltoid**

**Biceps**

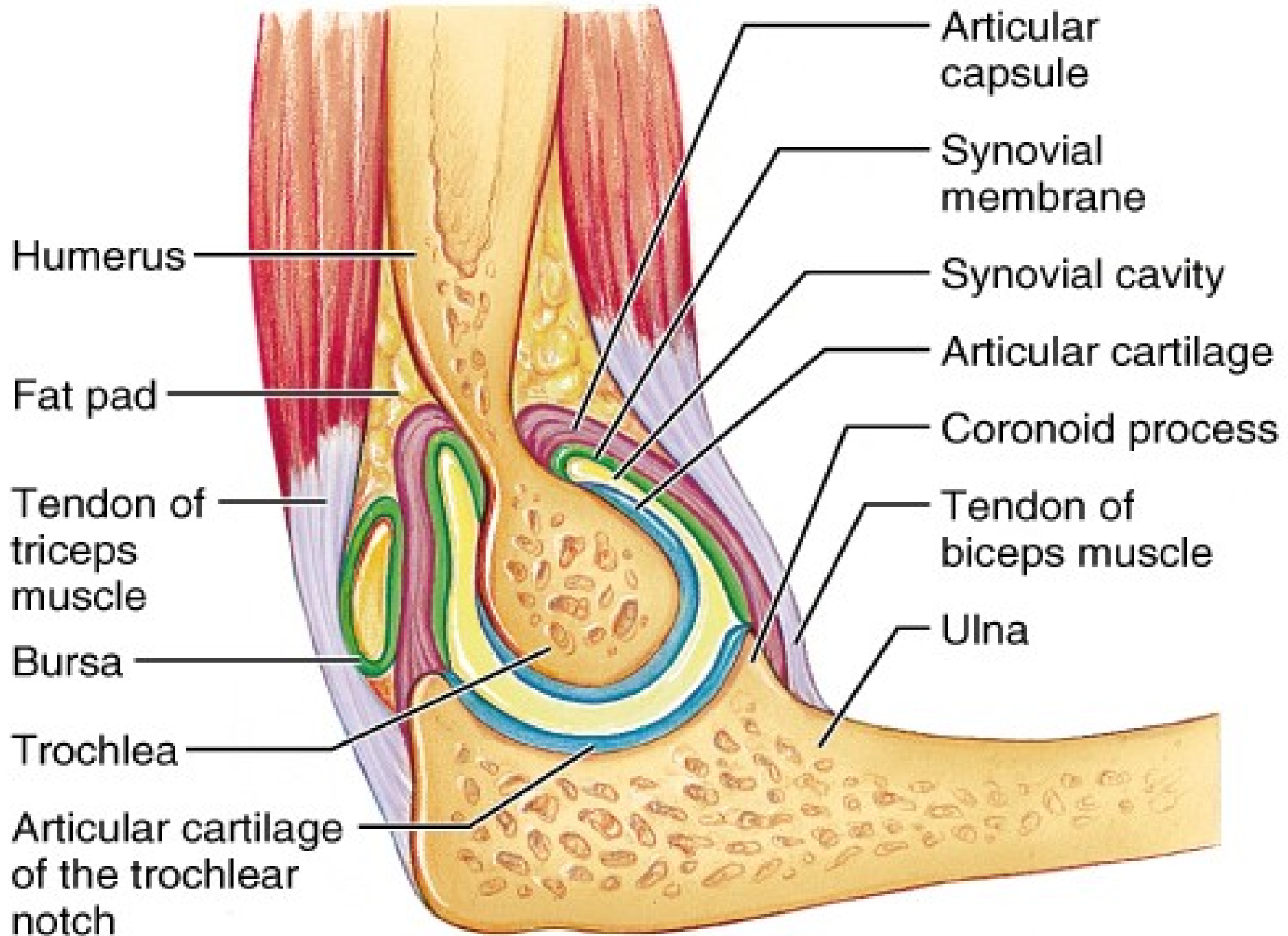
**Triceps**

**Coracobrachialis**



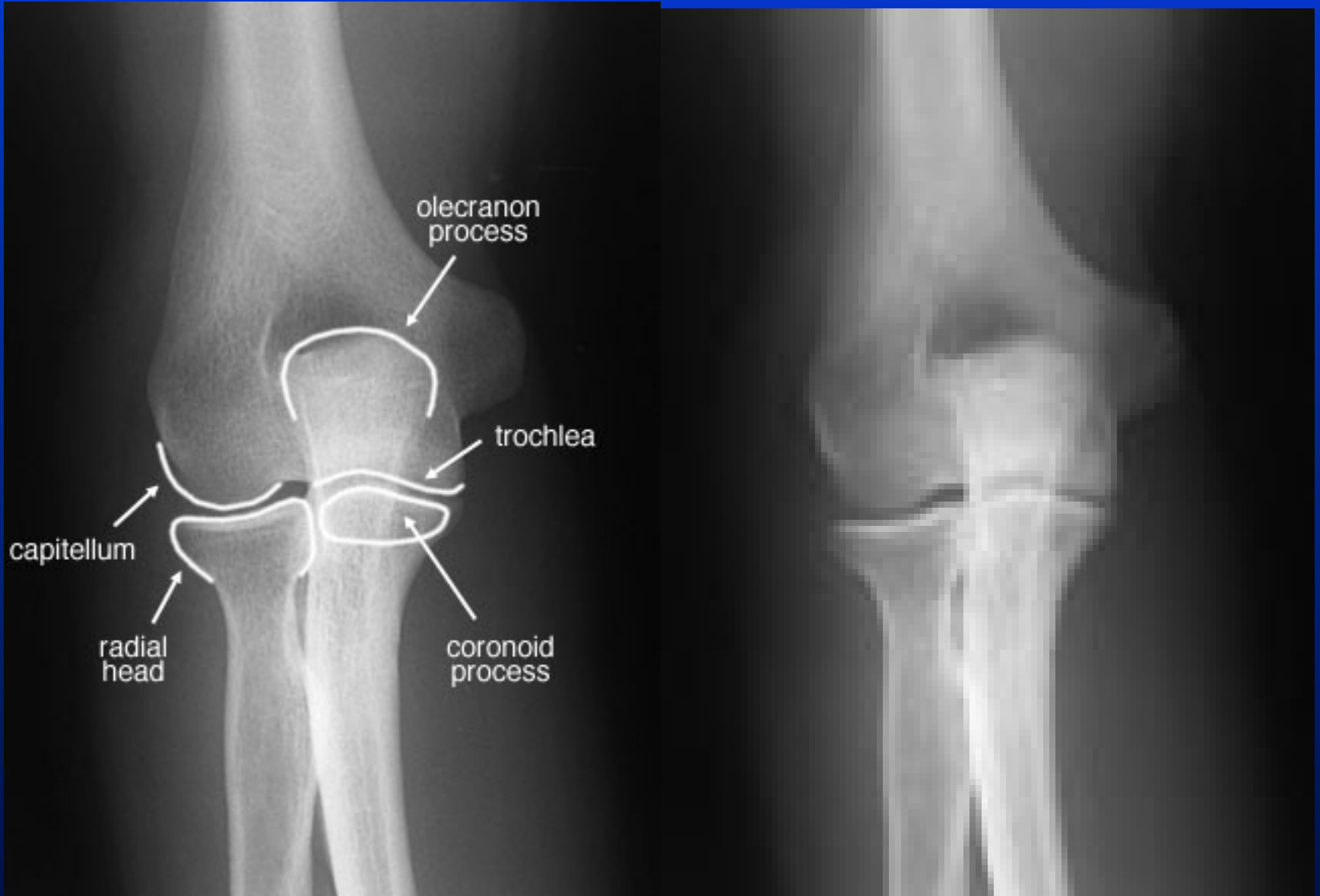


# **ELBOW JOINTS**





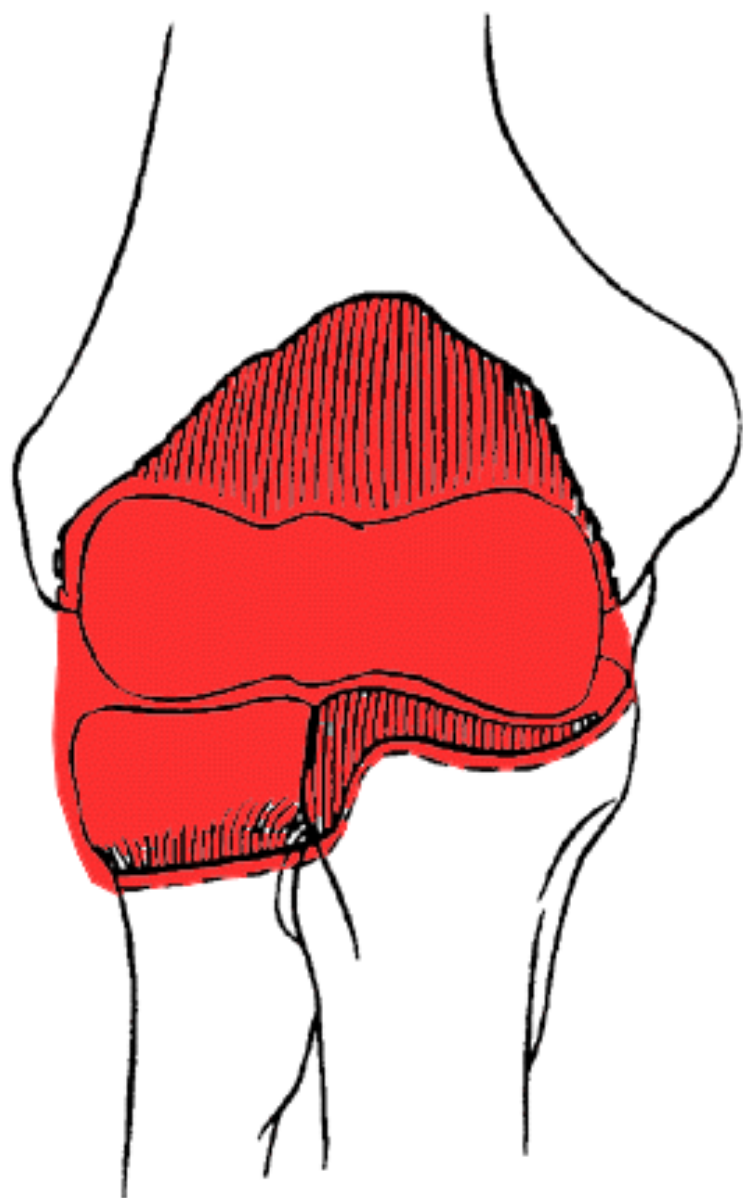
# **XRAY (AP)**



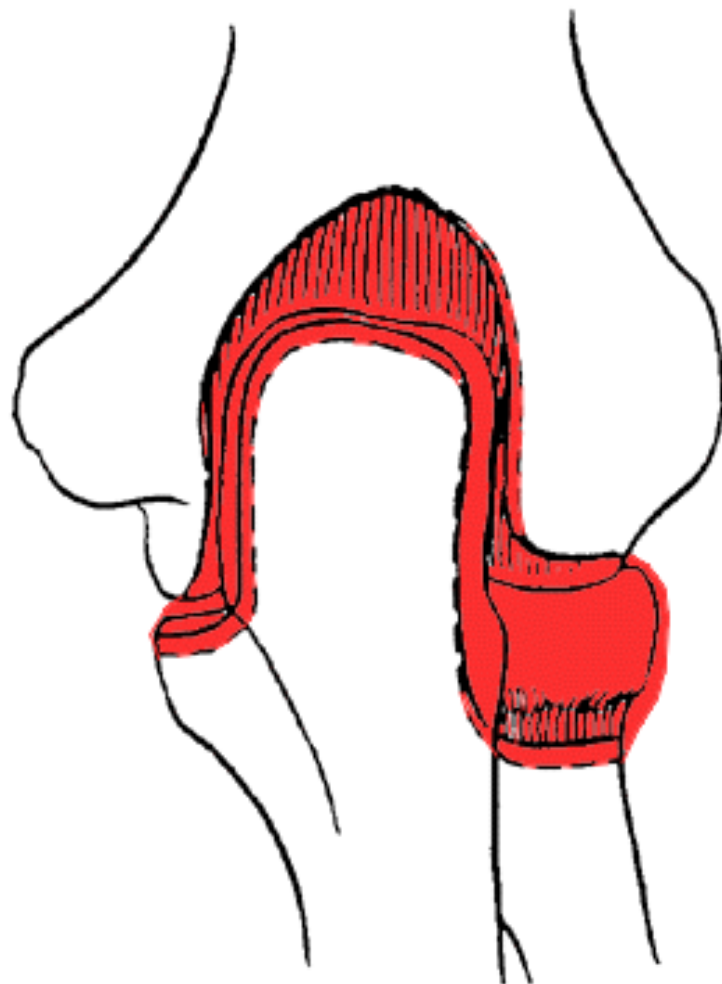


# ***XRAY (LATERAL)***

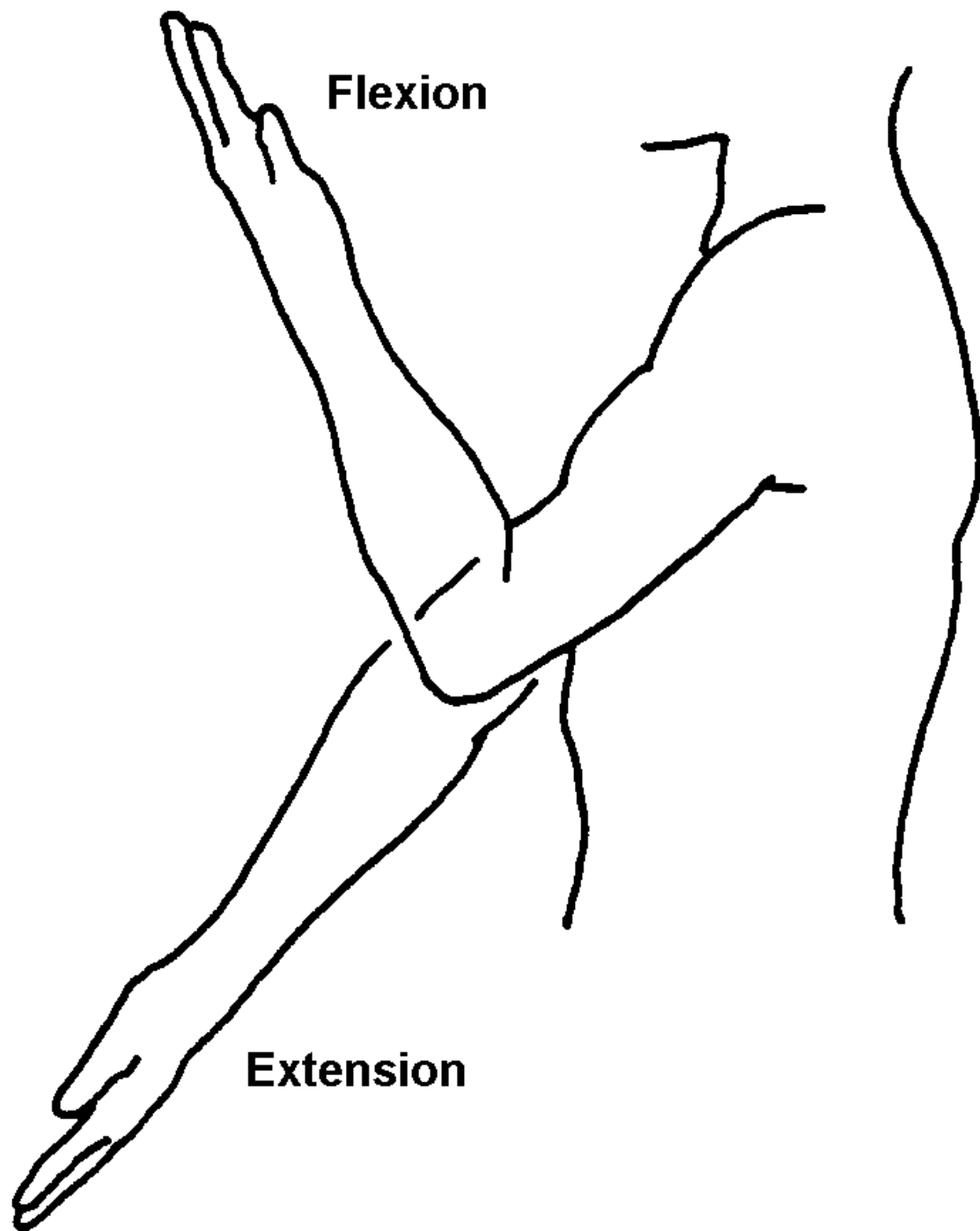




Anterior view

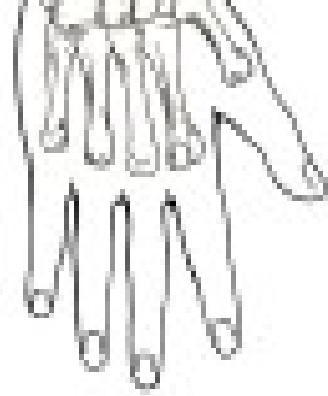


Posterior view



**Flexion**

**Extension**



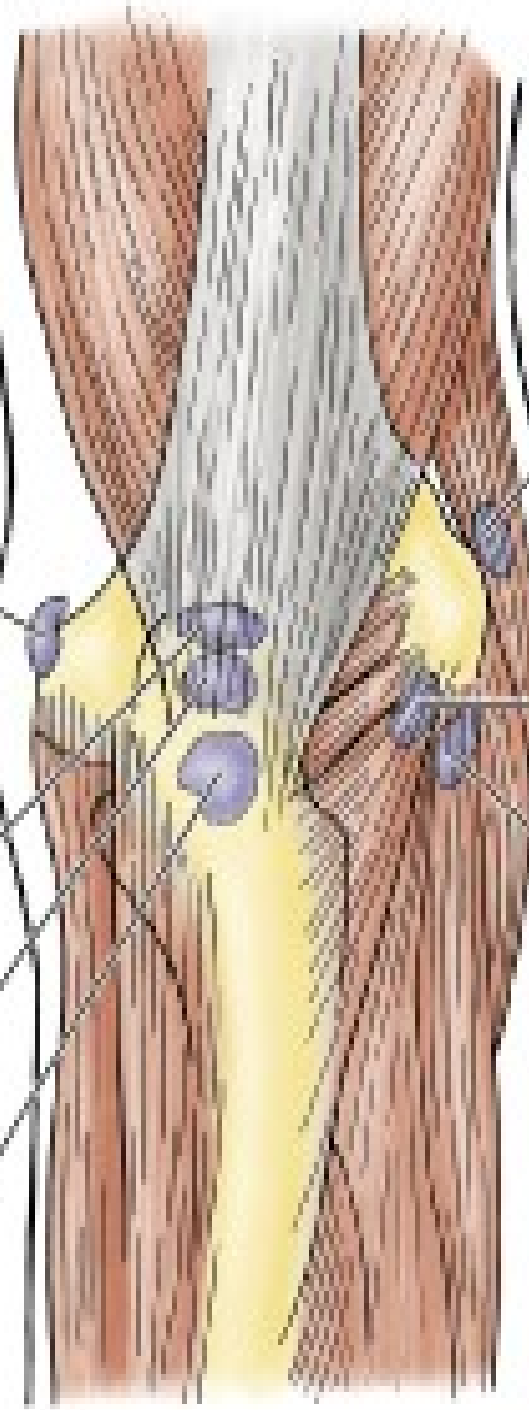
Subcutaneous  
bursa of medial  
epicondyle

Subcutaneous  
bursa on lateral  
epicondyle

Bursa of  
anconeus

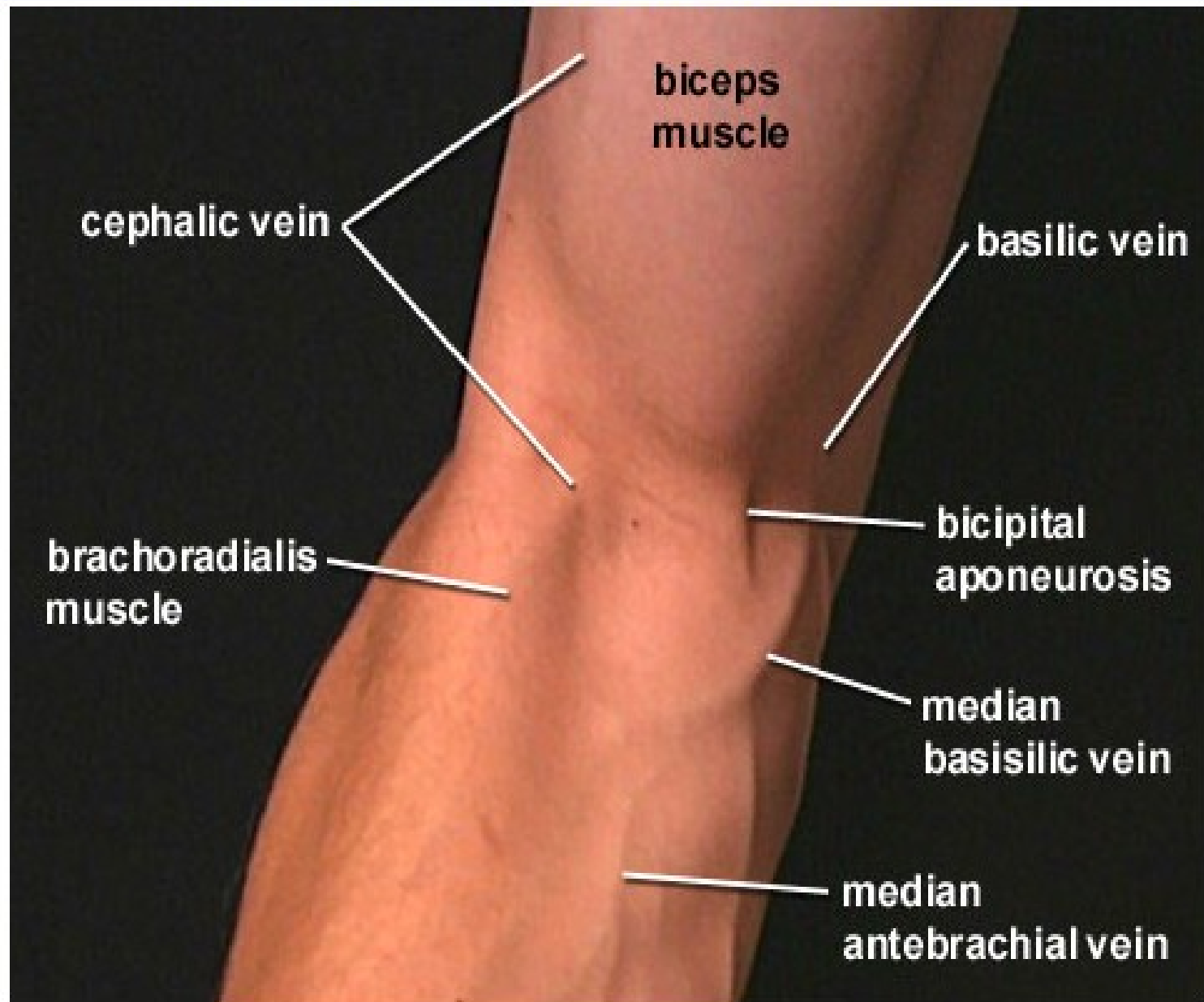
Bursa at origin  
of extensor carpi  
radialis brevis

Olecranon  
bursae {  
Subtendinous  
Intratendinous  
Subcutaneous

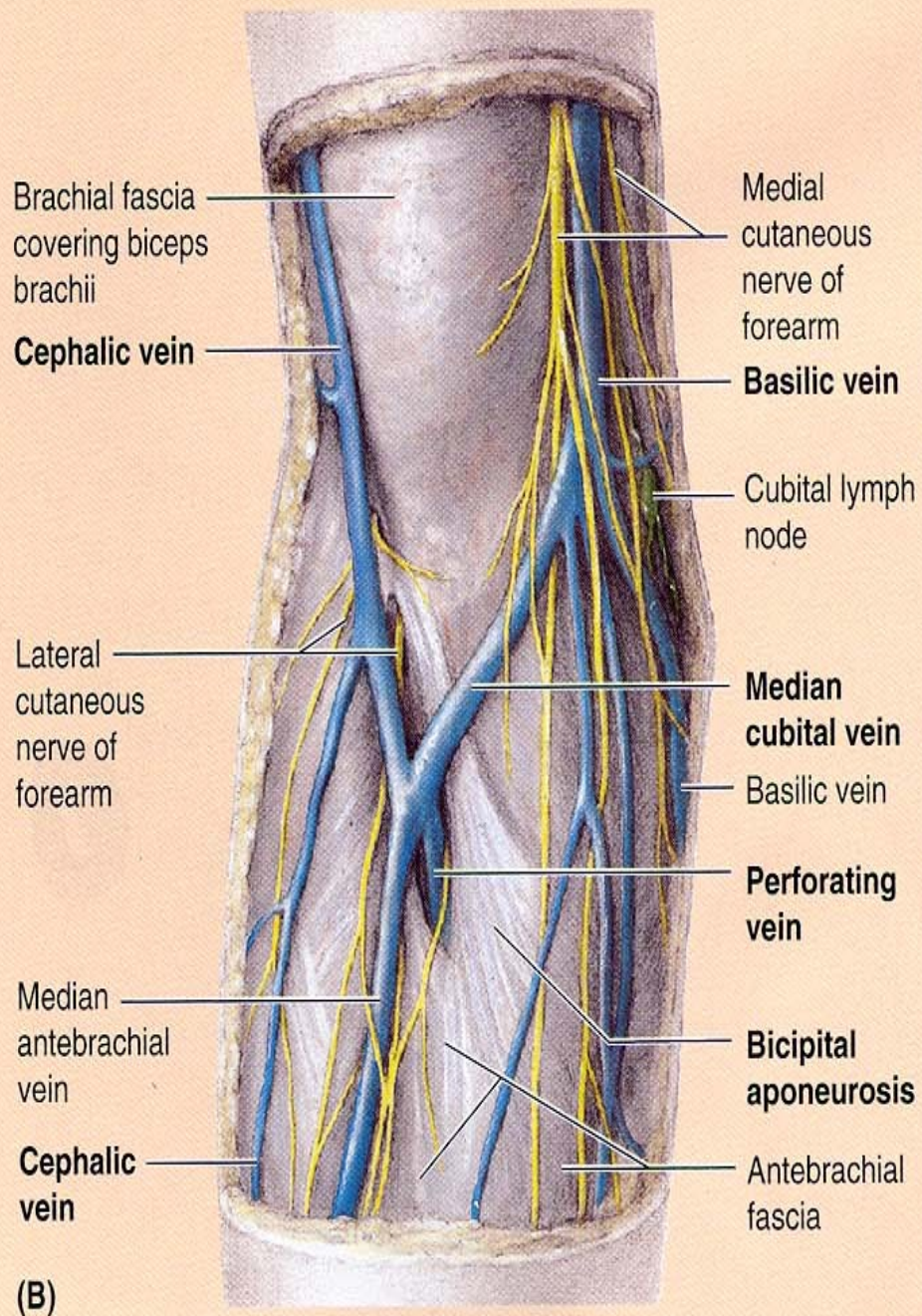
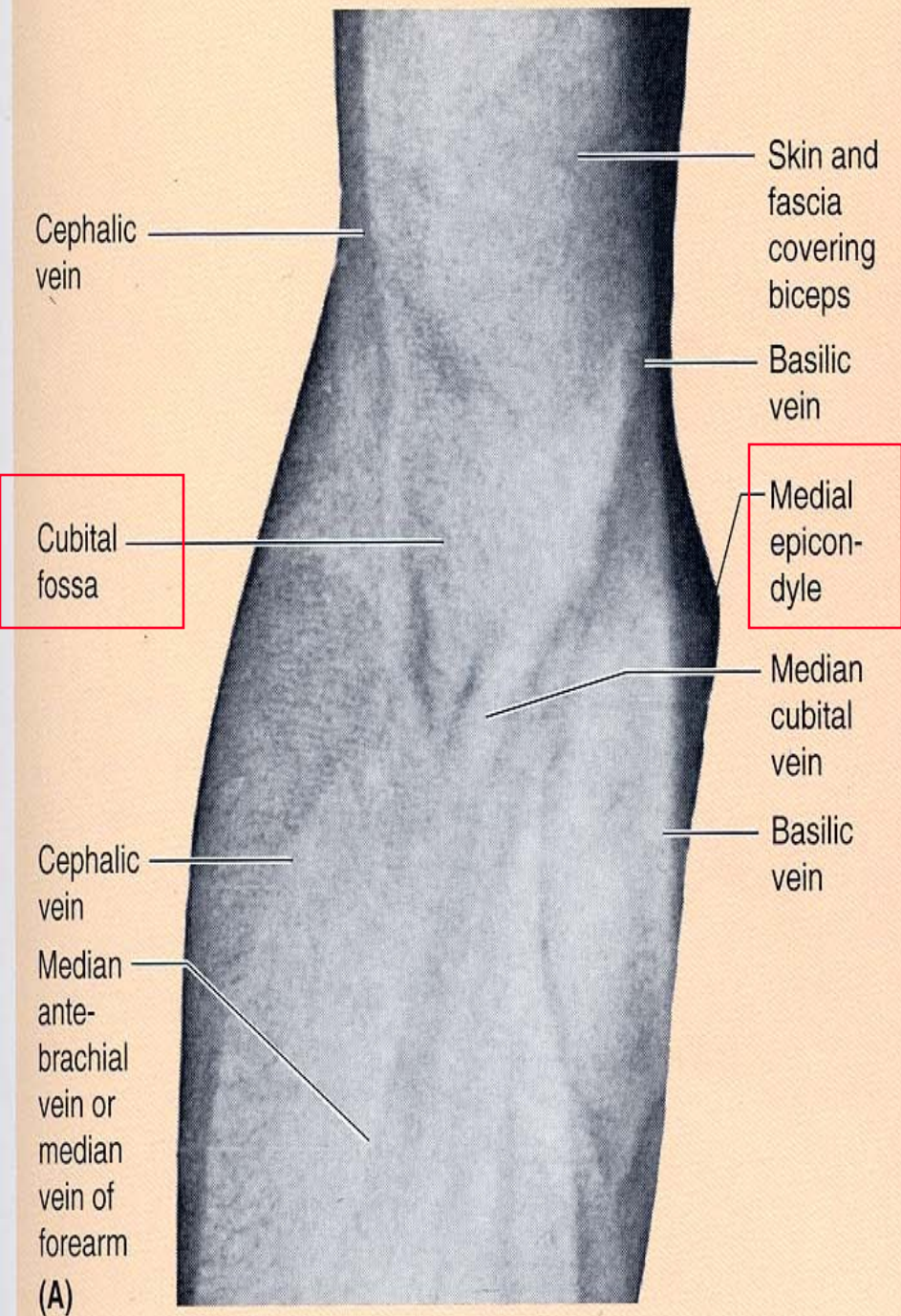


# **CUBITAL FOSSA**

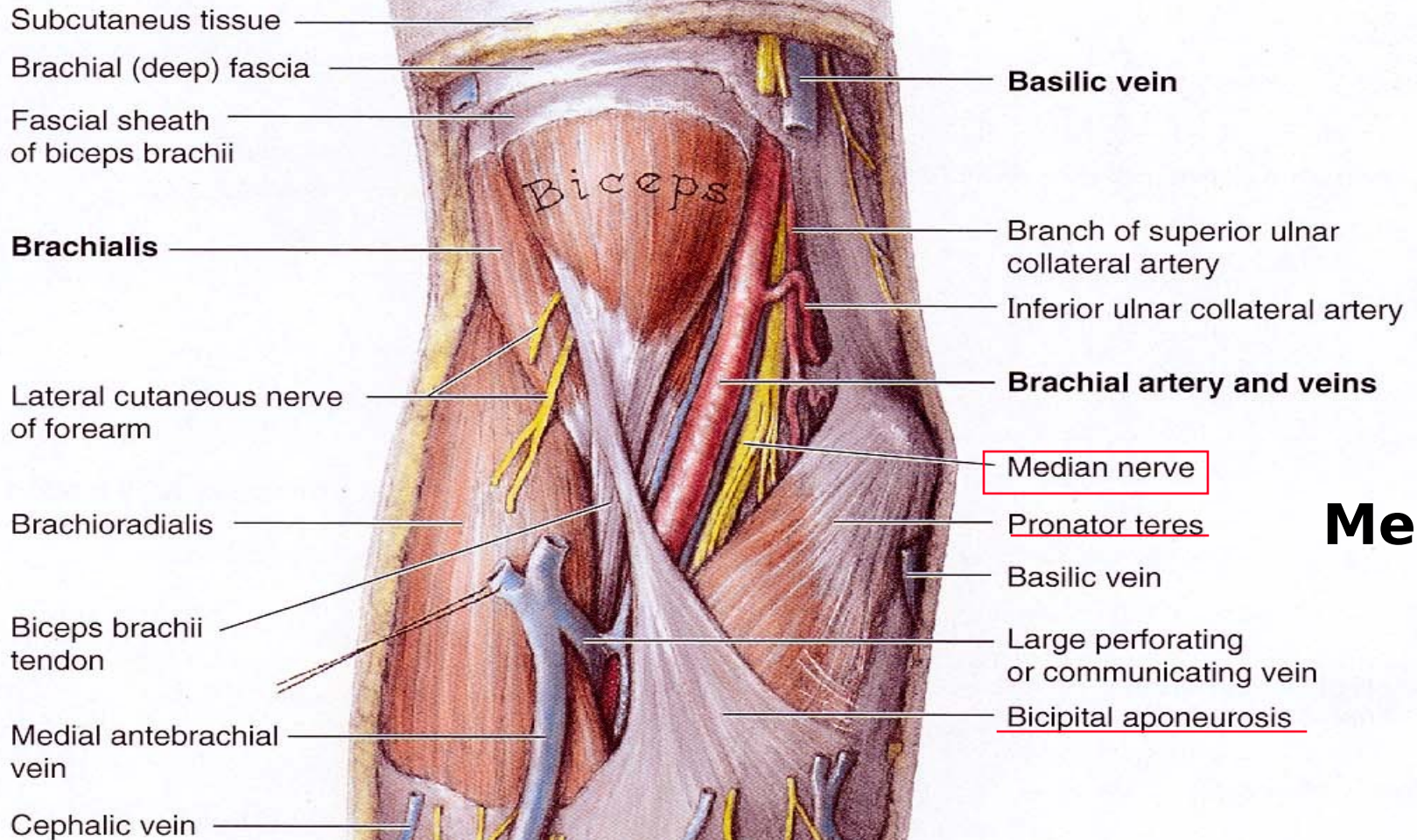
## Surface Anatomy: Cubital Fossa (right)





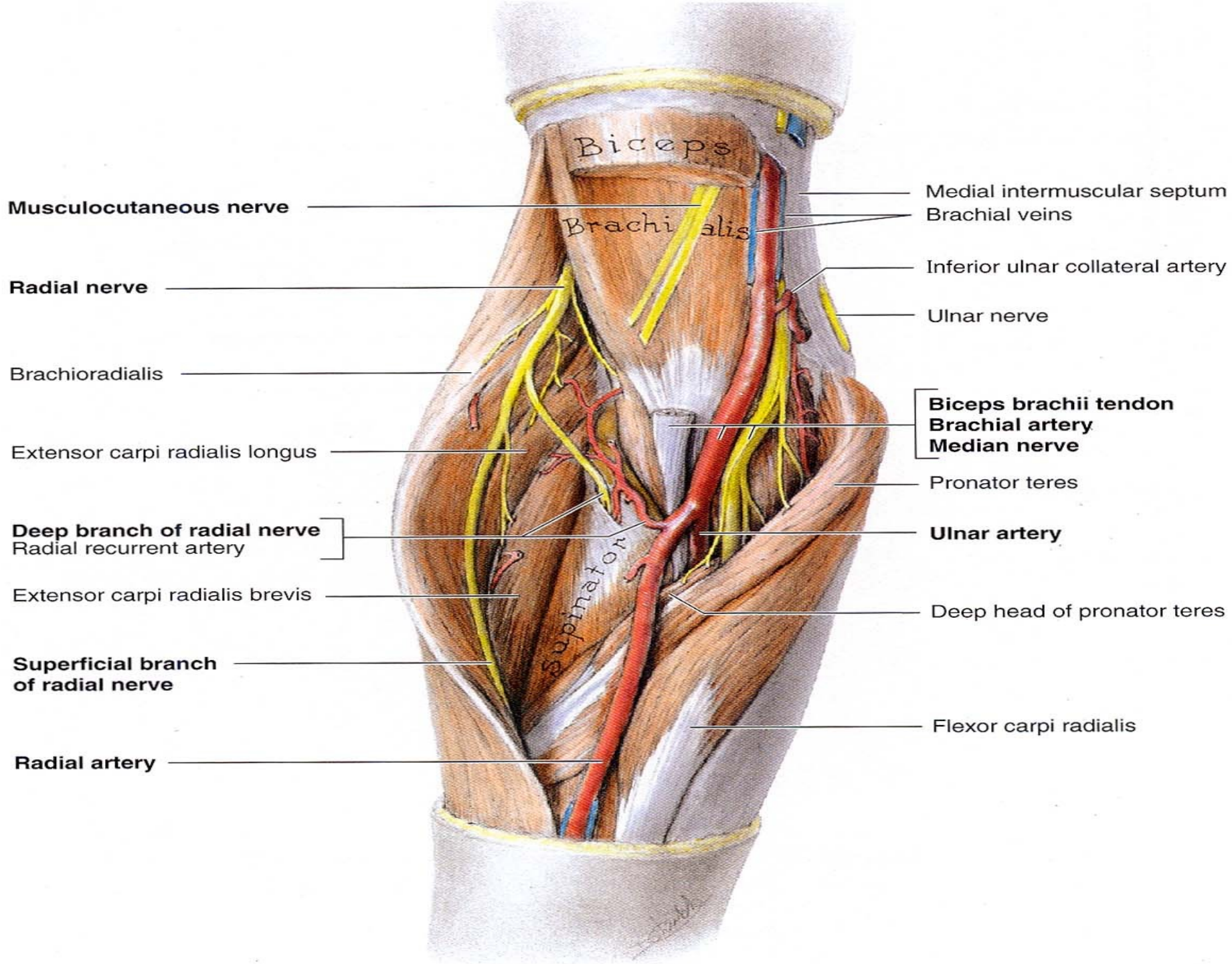






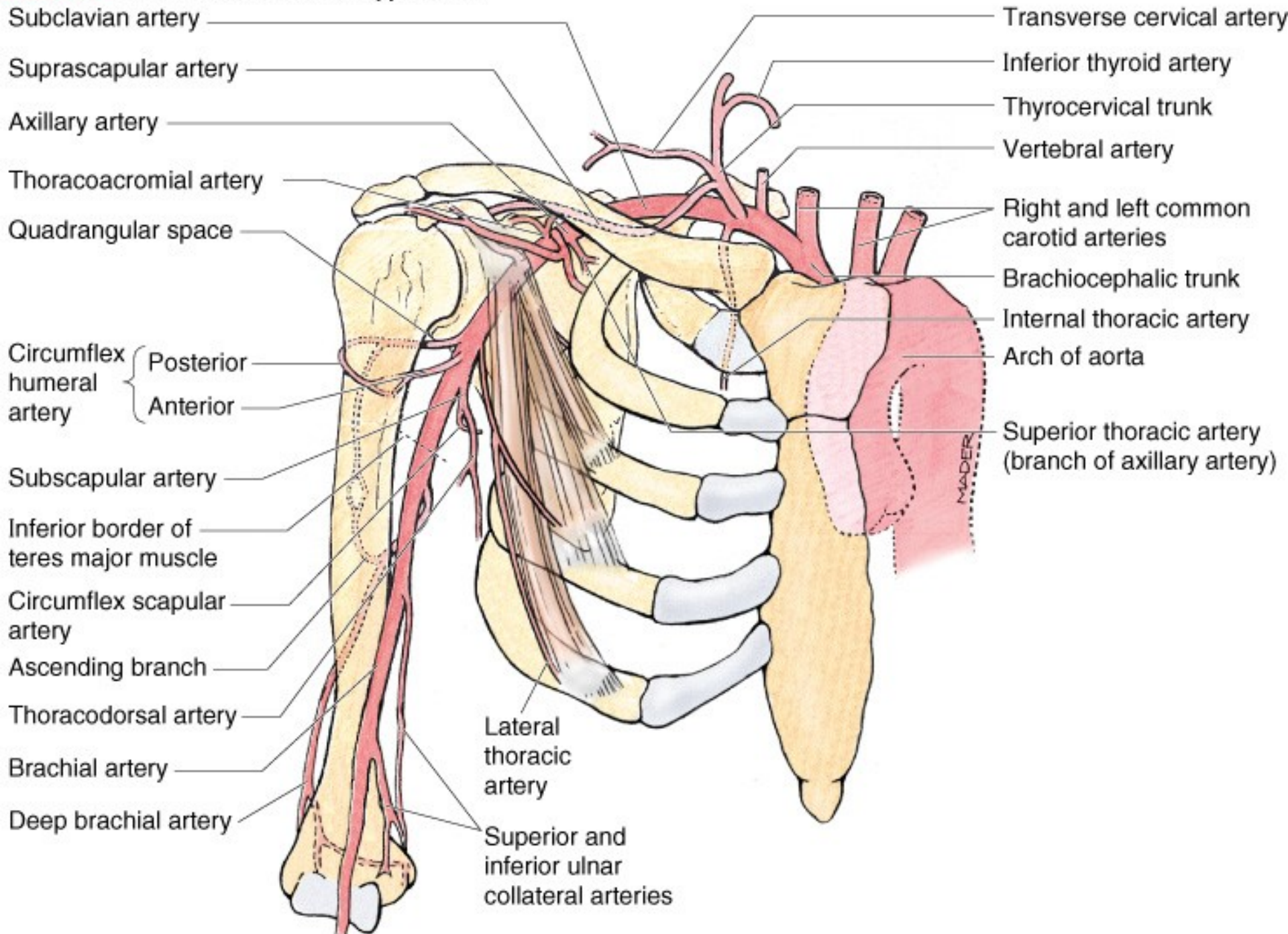
**Medial**



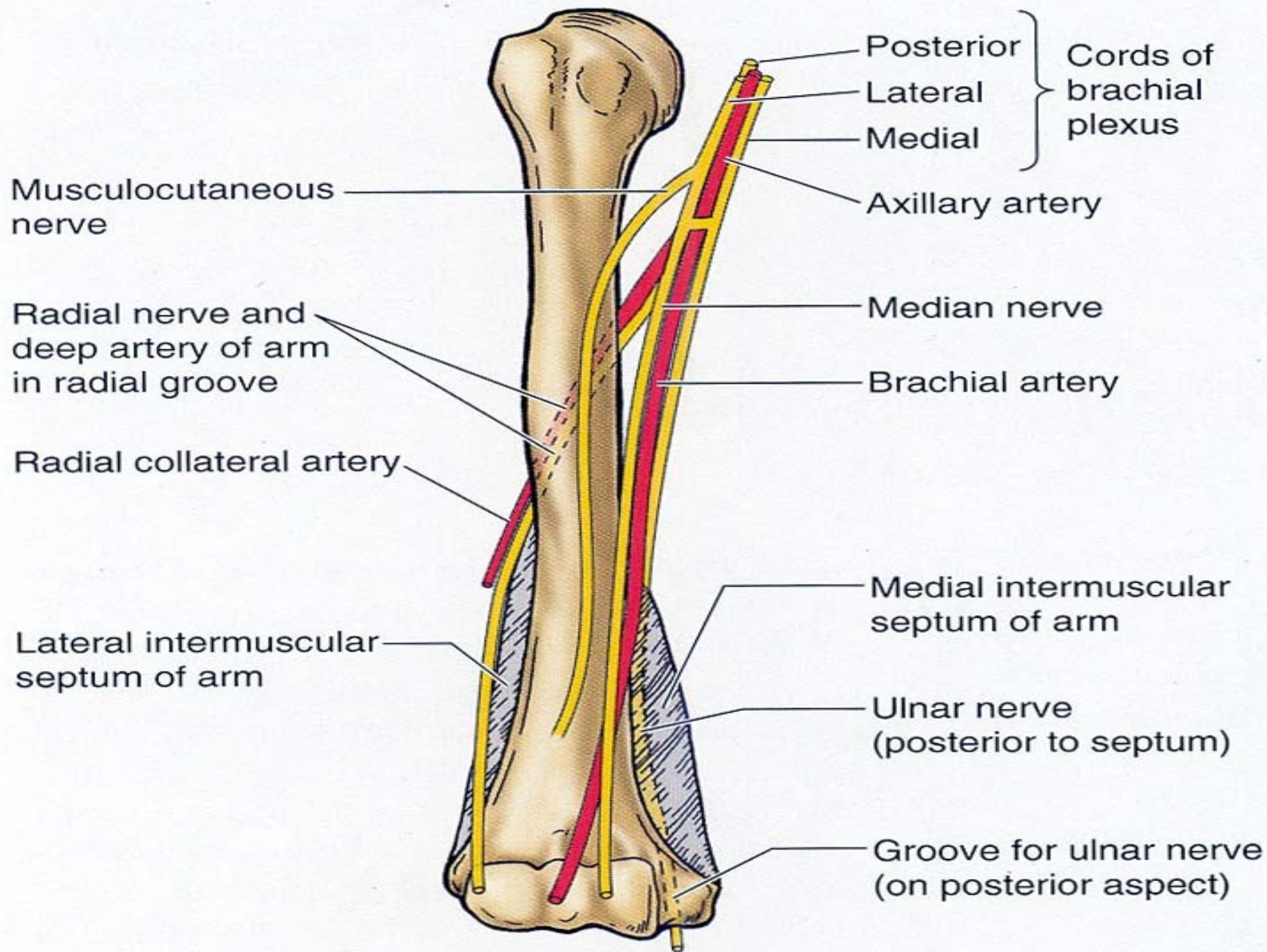


# **ARTERIAL SUPPLY**

**Table 6.3. Arteries of the Proximal Upper Limb**

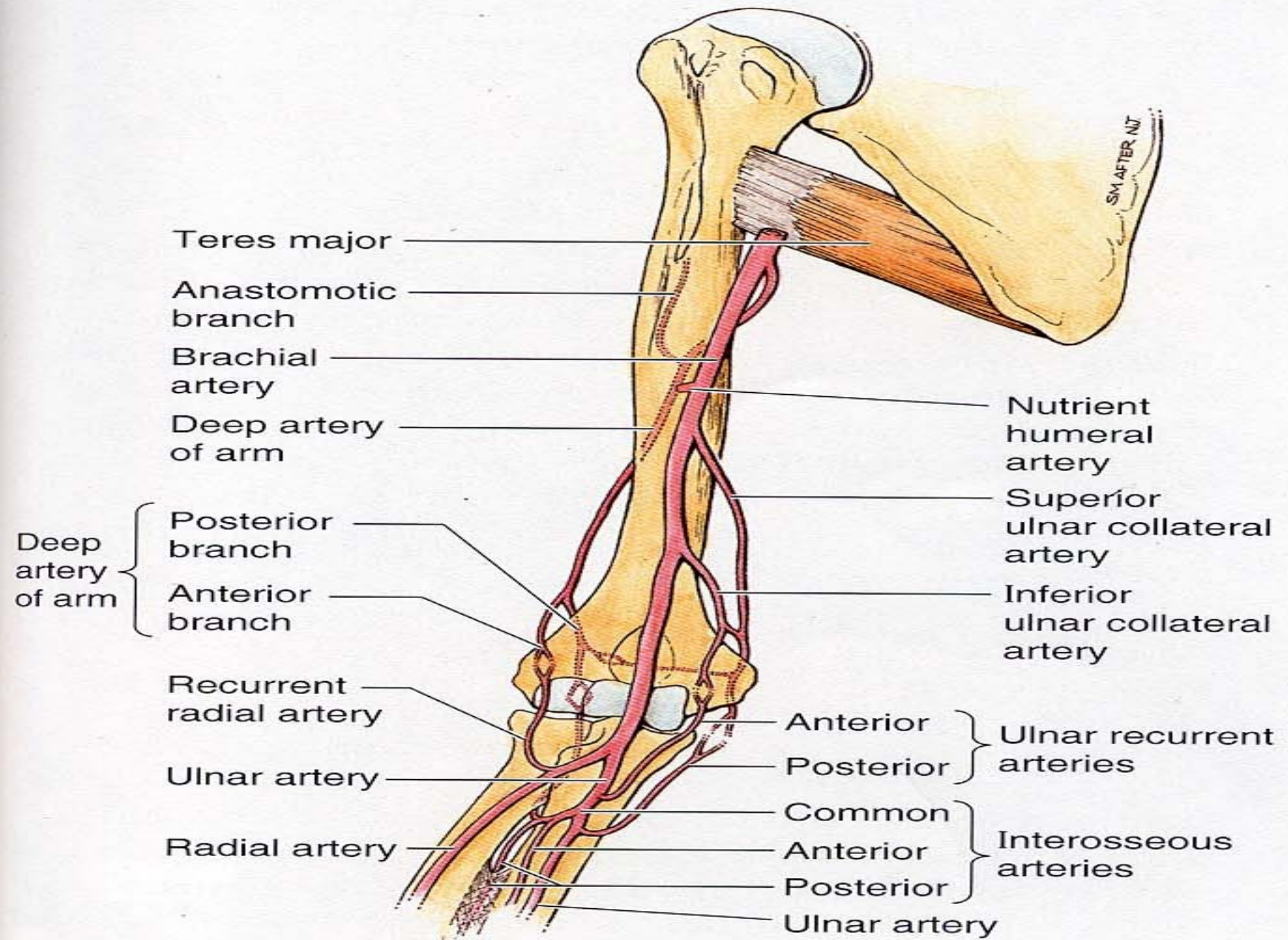






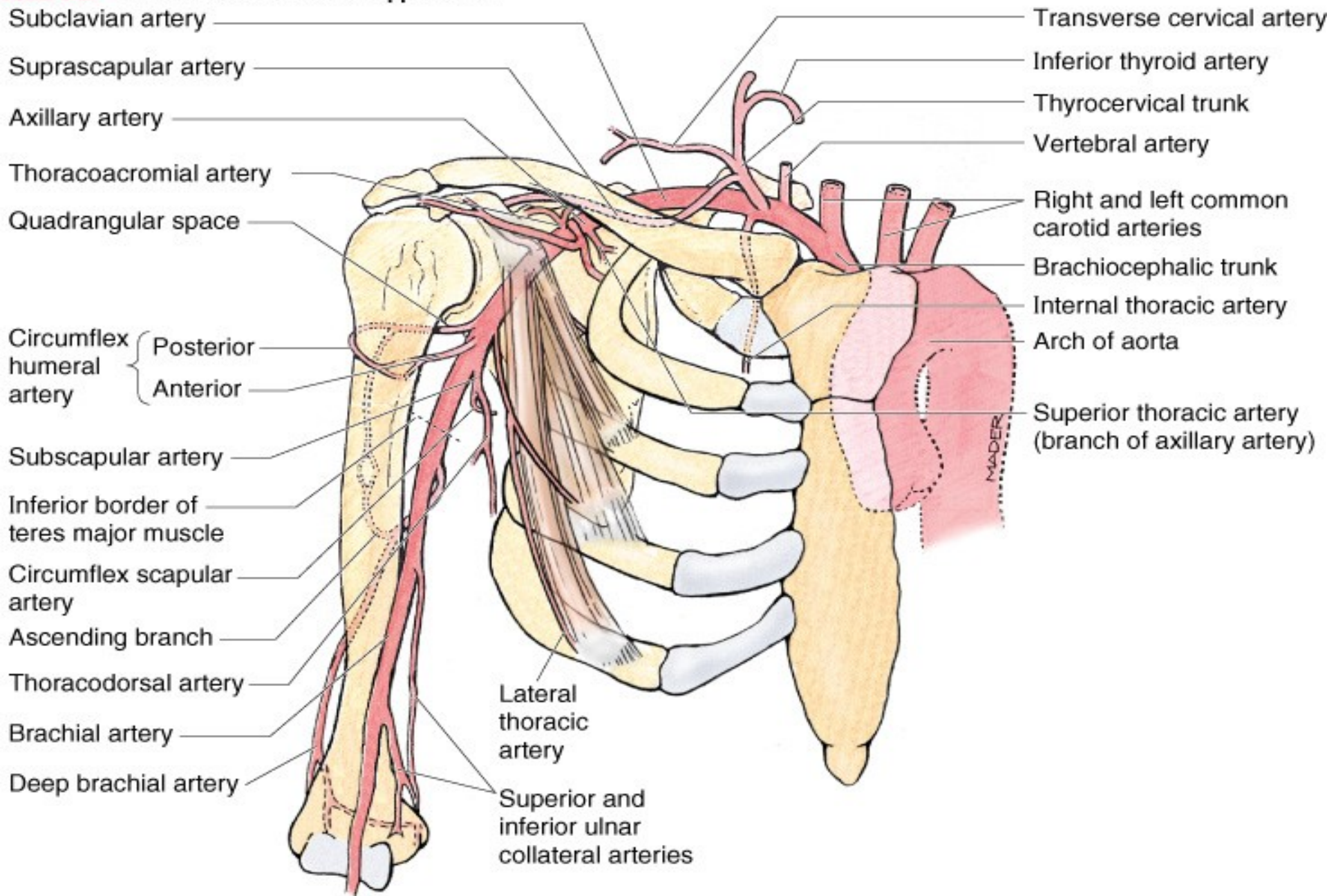
**Figure 6.36. Arterial supply of the arm and the proximal part of the forearm.** Observe the functionally and clinically important arterial anastomoses around the elbow. These pathways for collateral circulation allow blood to reach the forearm when flexion of the elbow compromises flow through the terminal part of the brachial artery.







**Table 6.3. Arteries of the Proximal Upper Limb**



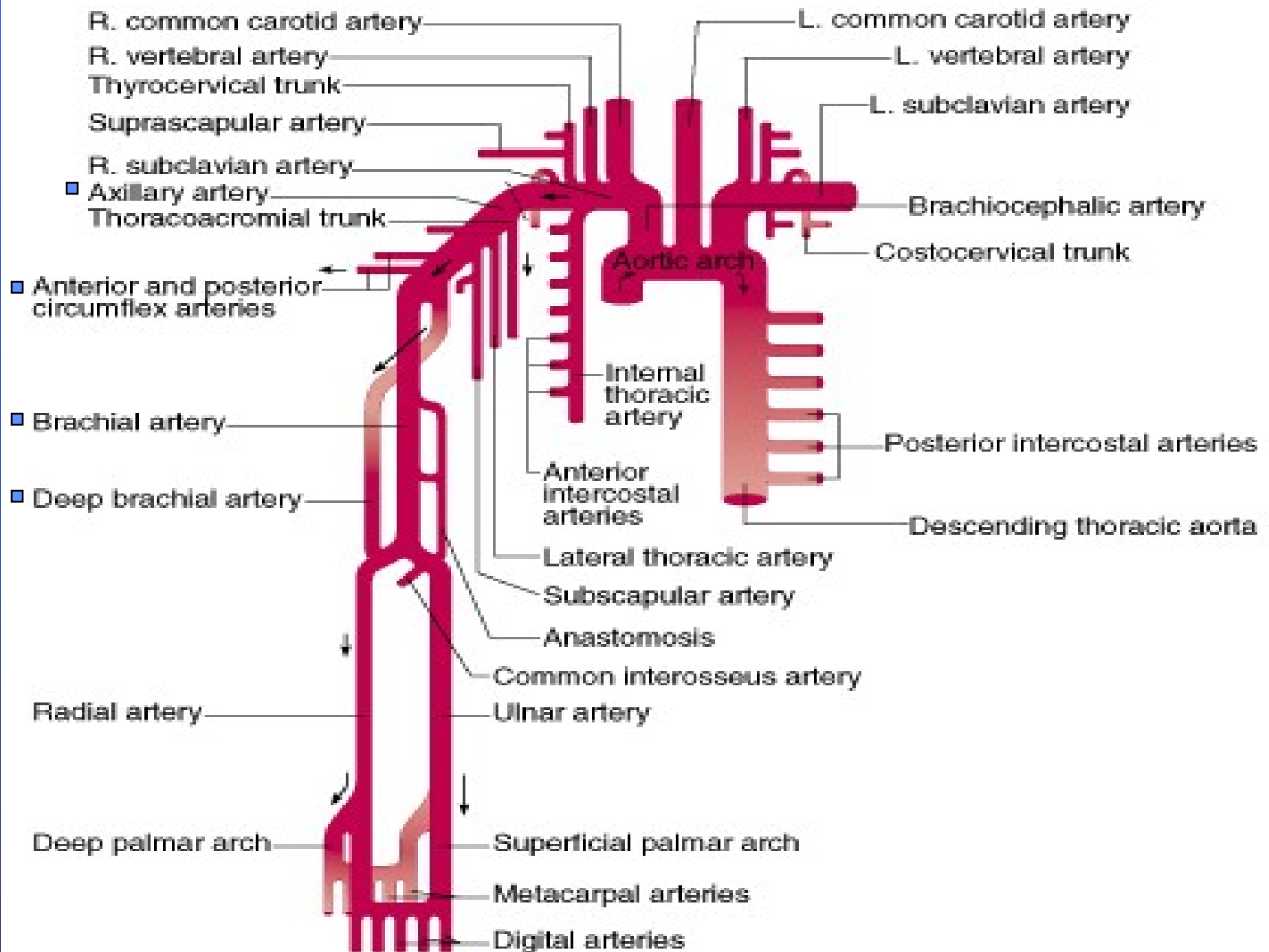
**Anterior view**

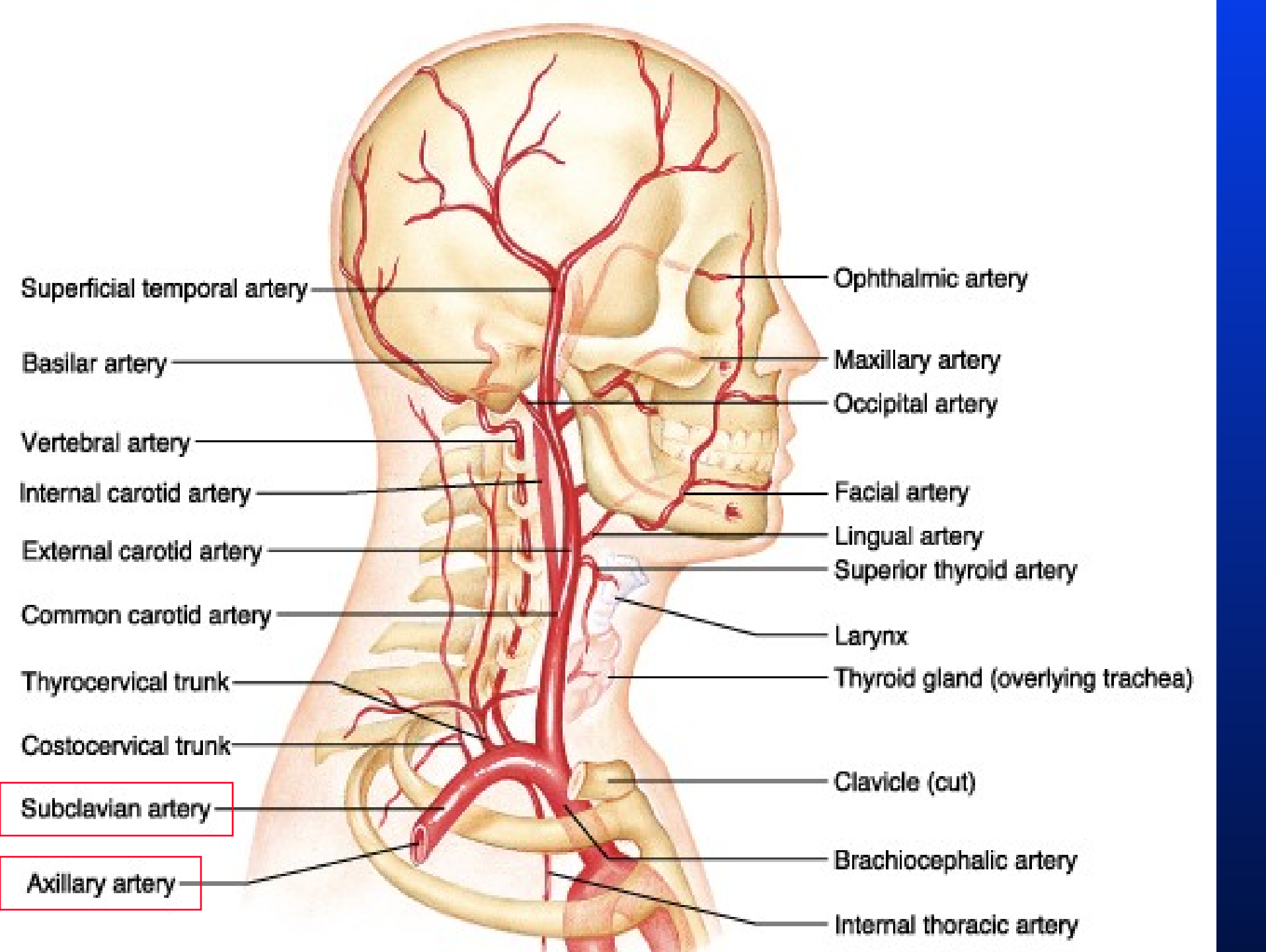
**Table 6.3.** (Continued) **Arteries of the Proximal Upper Limb**

Artery	Origin	Course
Thoracodorsal	Subscapular artery	Continues course of subscapular artery and accompanies thoracodorsal nerve to latissimus dorsi
Anterior and posterior circumflex humeral	Third part of axillary artery	These arteries anastomose to form a circle around surgical neck of humerus; larger posterior circumflex humeral artery passes through quadrangular space with axillary nerve
Deep brachial	Brachial artery near its origin	Accompanies radial nerve through radial groove in humerus and takes part in anastomosis around elbow joint
Ulnar collateral (superior and inferior)	Superior ulnar collateral artery arises from brachial artery near middle of arm; inferior ulnar collateral artery arises from brachial artery just superior to elbow	Superior ulnar collateral artery accompanies ulnar nerve to posterior aspect of elbow; inferior ulnar collateral artery divides into anterior and posterior branches; both ulnar collateral arteries take part in anastomosis around elbow joint

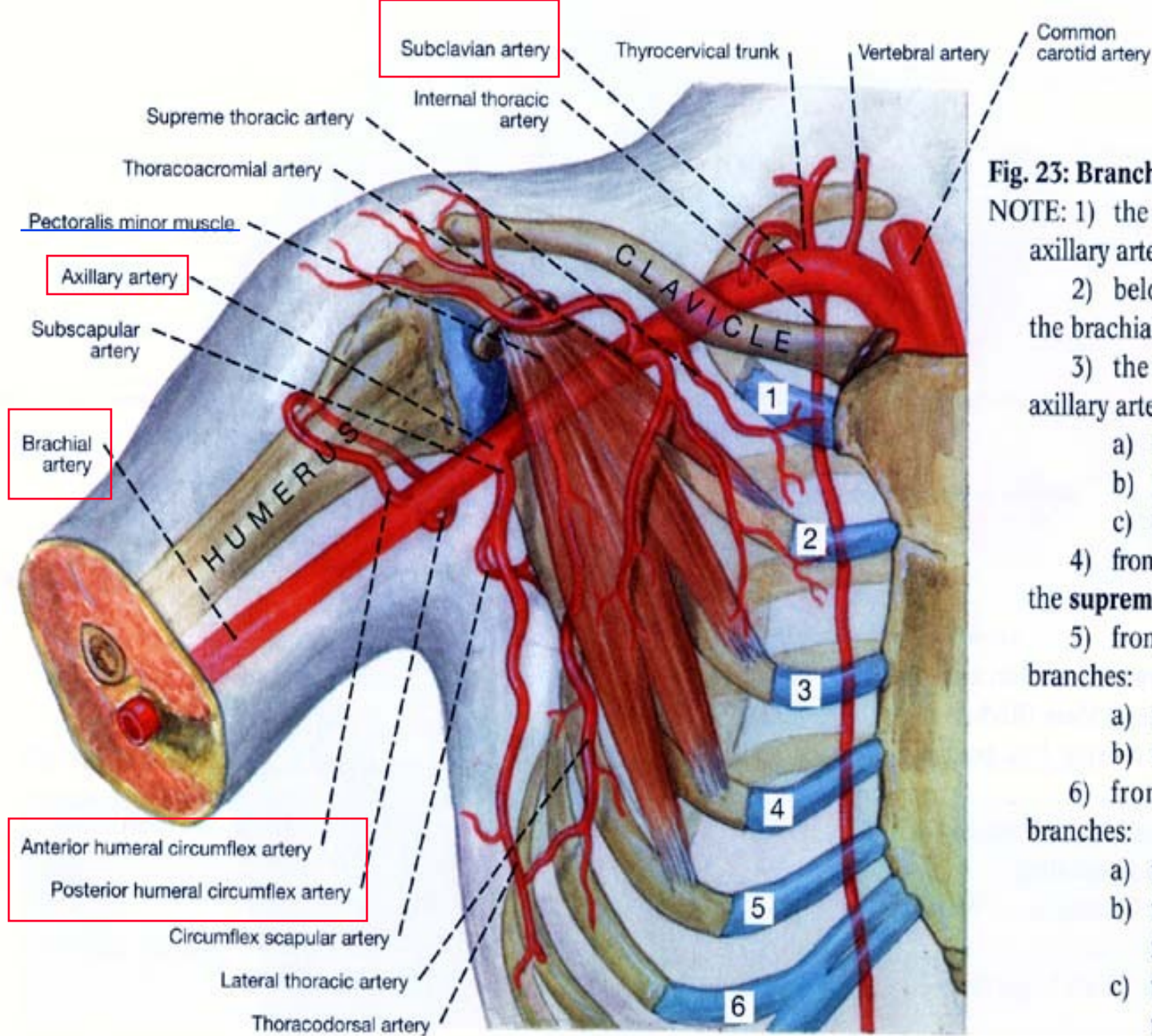
# ARTERIES OF THE ARM

- Axillary artery (& vein)
- Circumflex humeral arteries - Posterior & Anterior
- Subscapular artery
- Brachial artery (& vein)
  - Deep brachial artery (profunda)









**Fig. 23: Branches of the Axillary Artery**

NOTE: 1) the subclavian artery becomes the axillary artery distal to the clavicle.

2) below the teres major, it becomes the brachial artery.

3) the pectoralis minor crosses the axillary artery, dividing it into three parts:

- a) medial to the muscle
- b) beneath the muscle
- c) lateral to the muscle

4) from the 1st part there is one branch, the **supreme thoracic artery**.

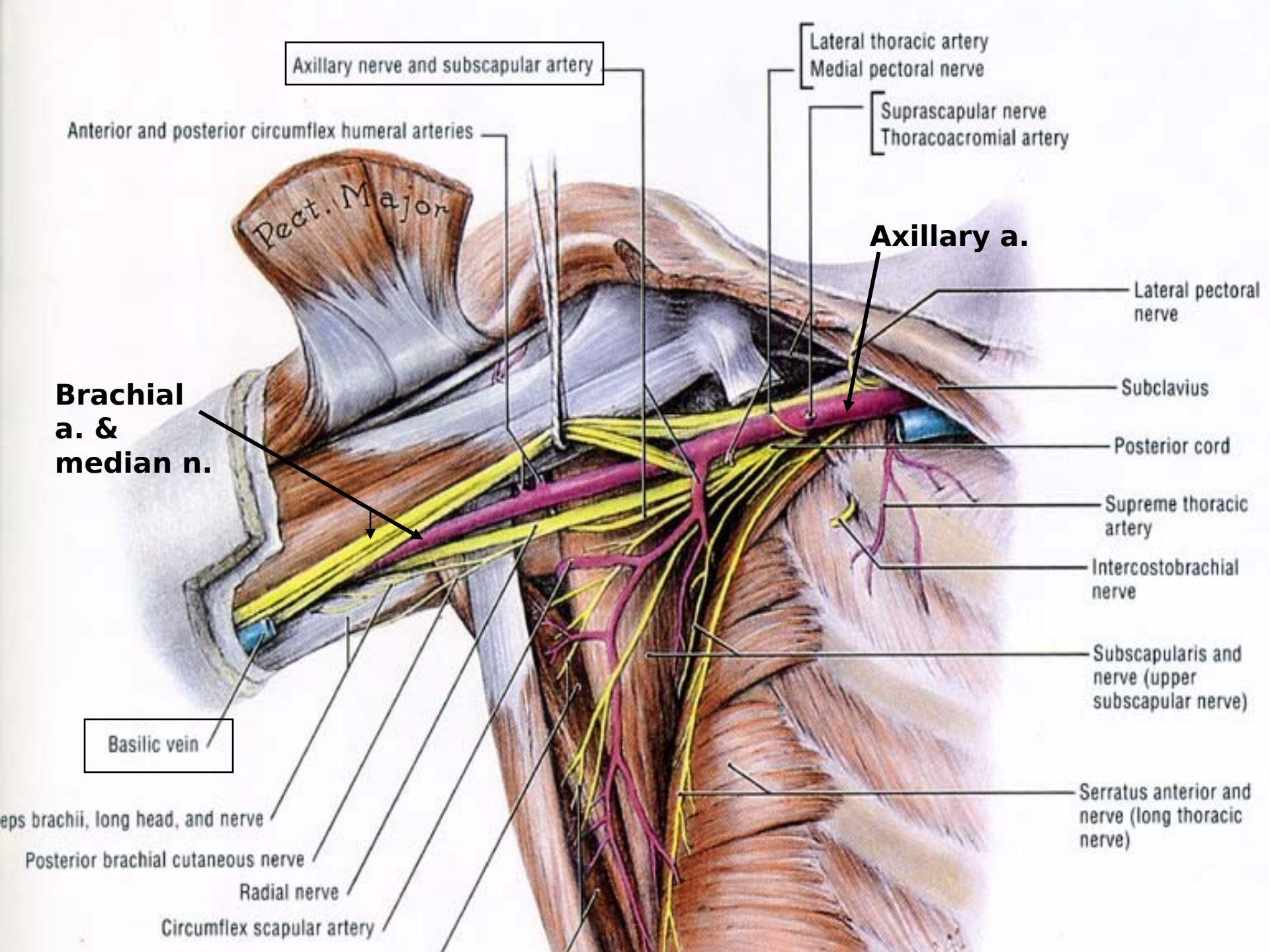
5) from the 2nd part are derived two branches:

- a) the **thoracoacromial artery**
- b) the **lateral thoracic artery**

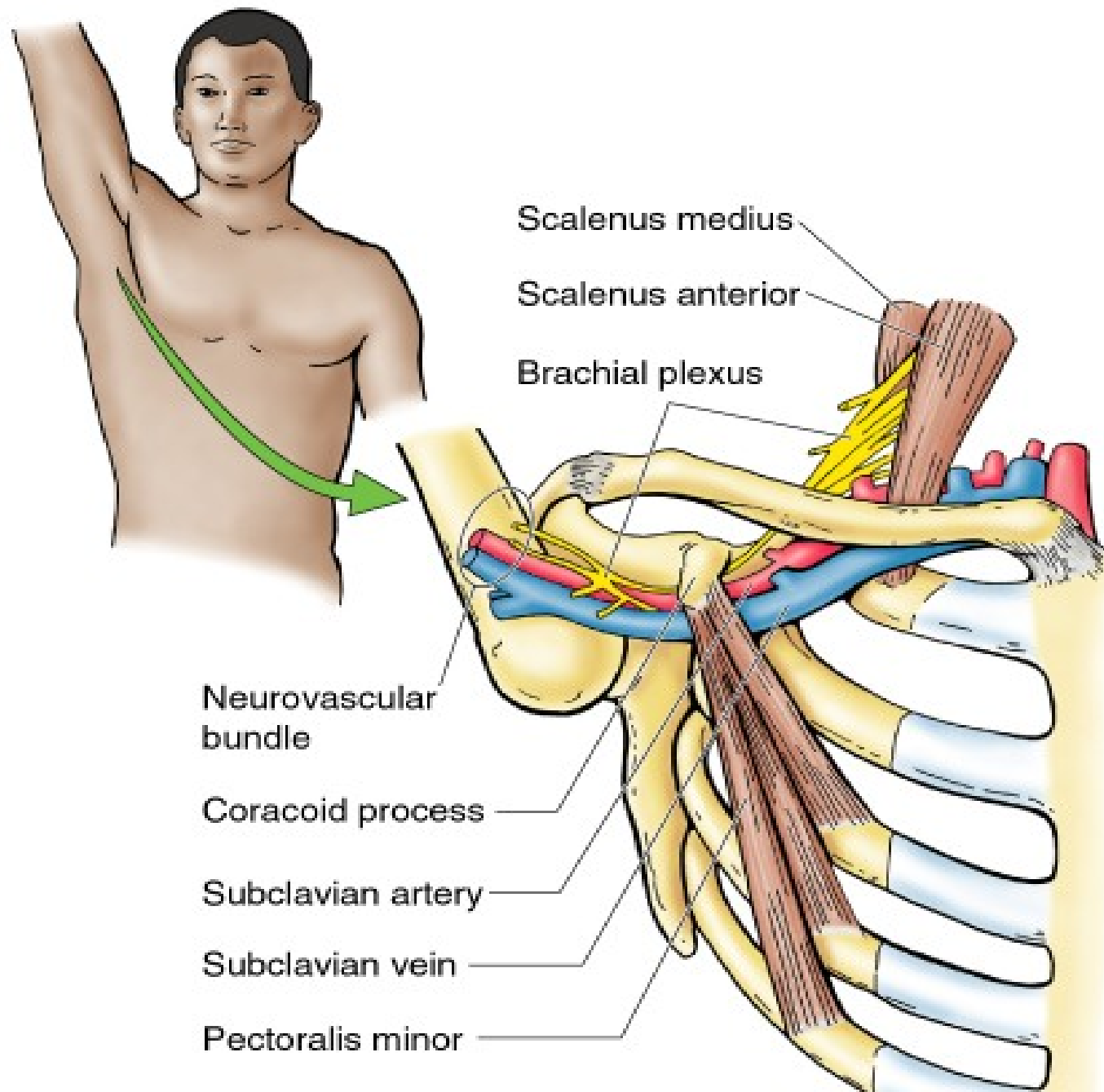
6) from the 3rd part come three branches:

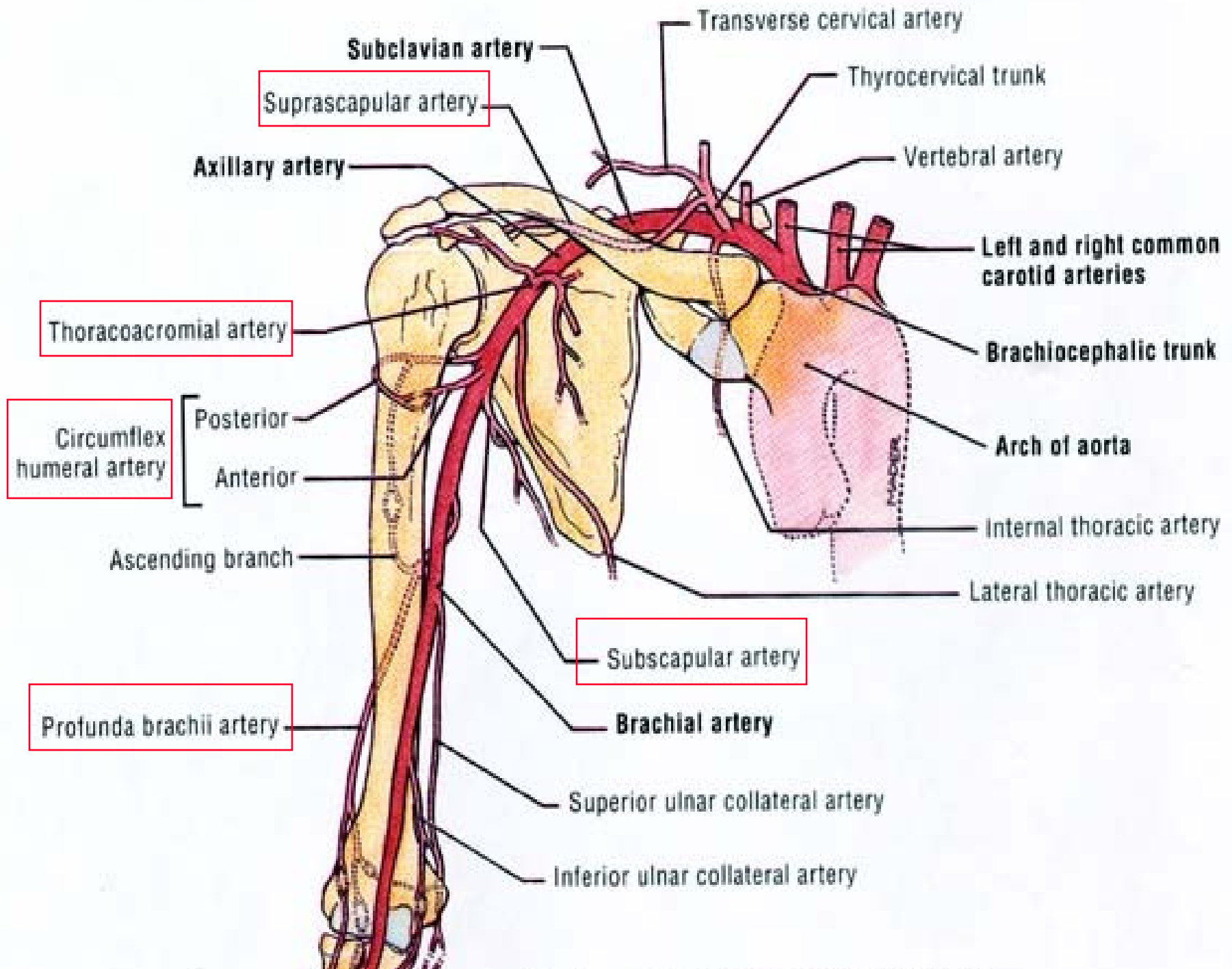
- a) the **subscapular artery**
- b) the **anterior humeral circumflex artery**,
- c) the **posterior humeral circumflex artery**





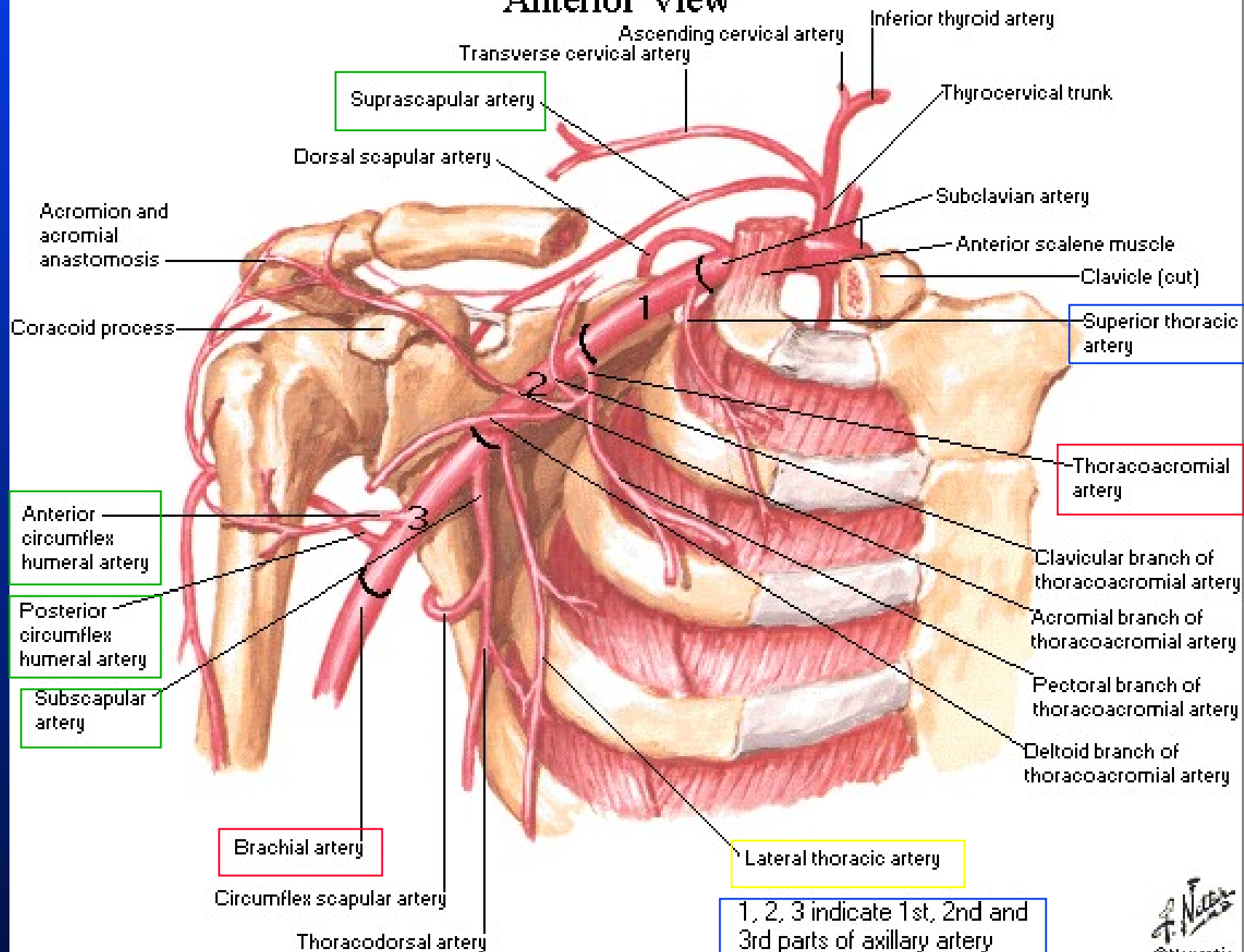


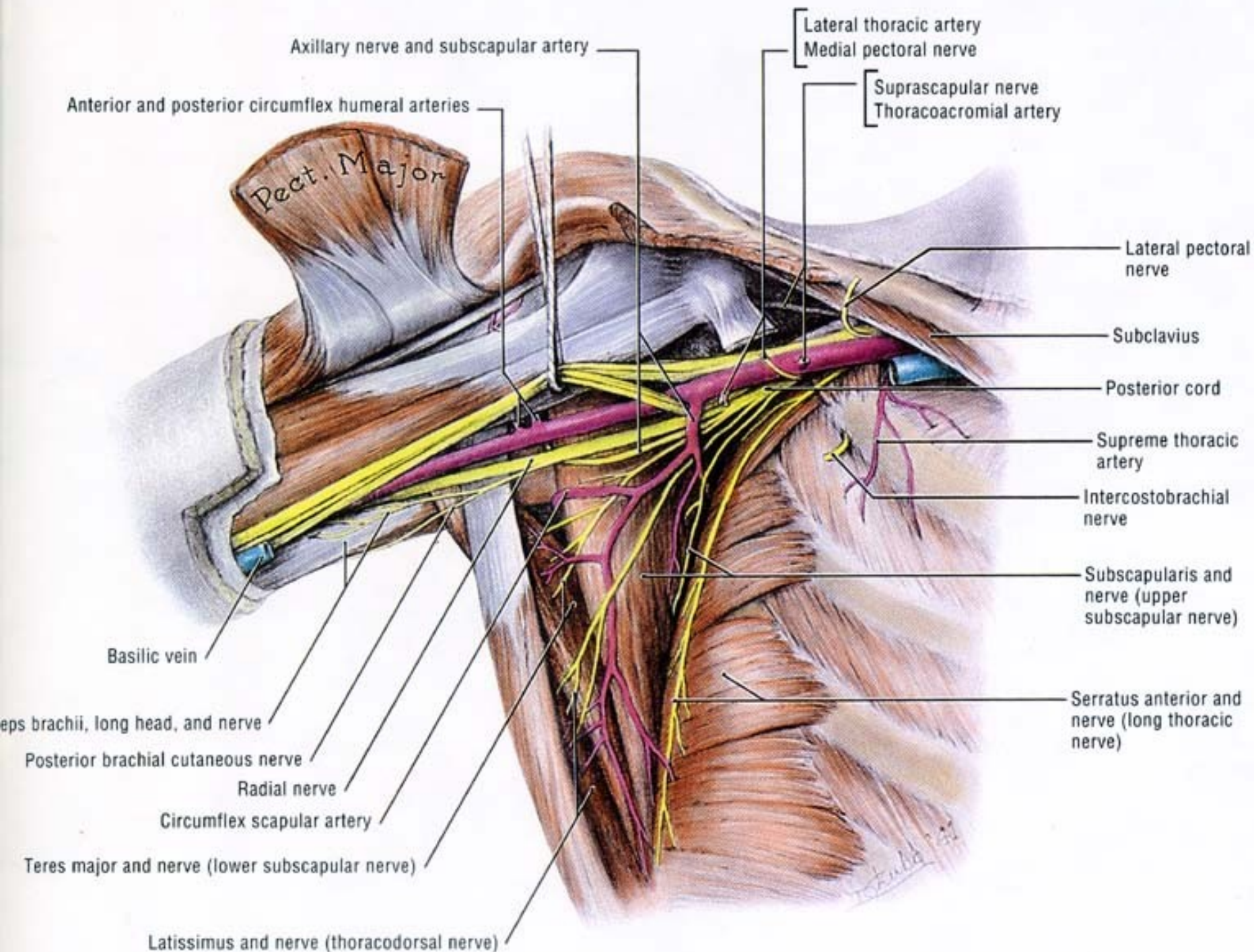


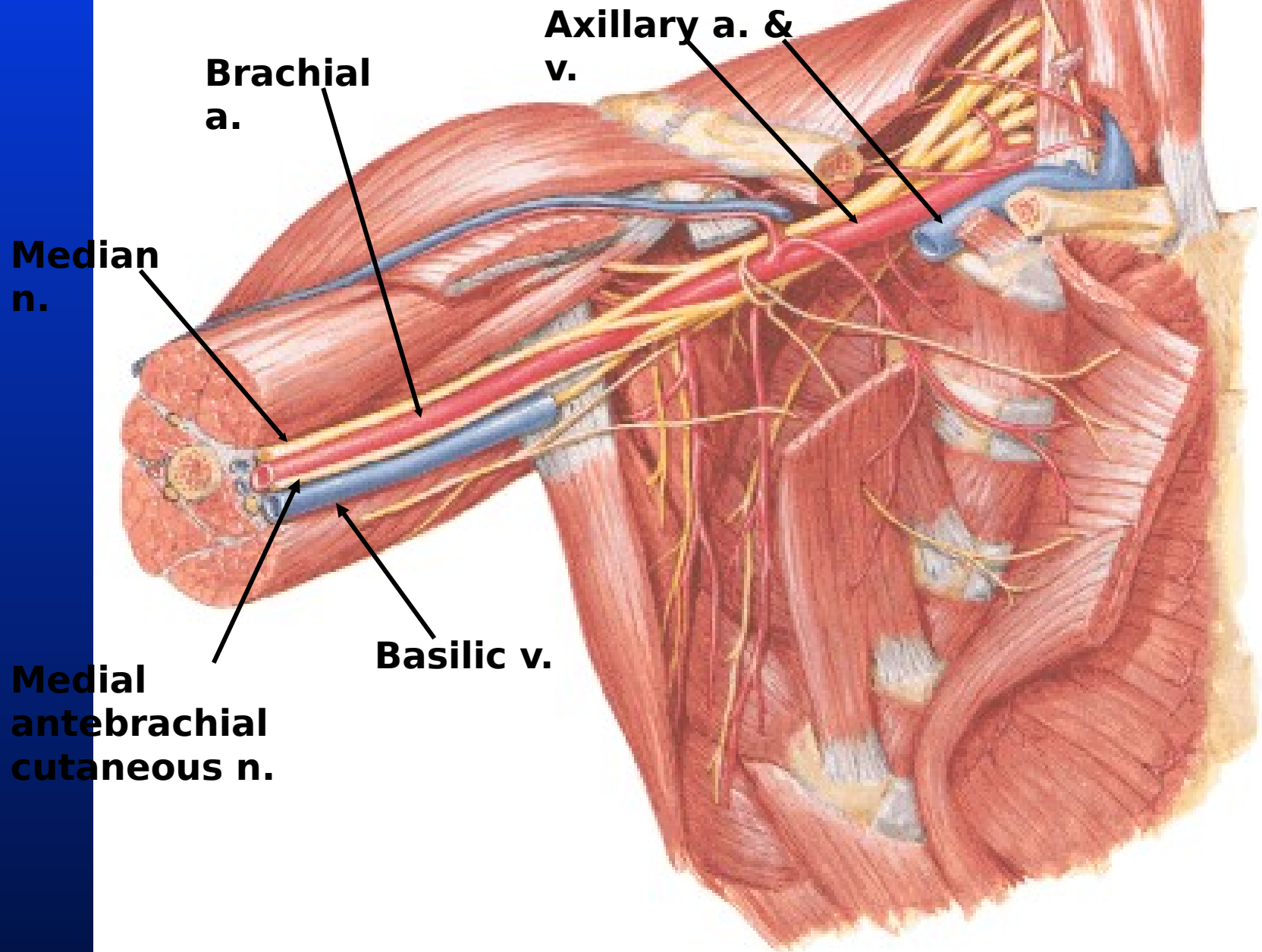


# Axillary Artery and Anastomoses Around Scapula

## Anterior View







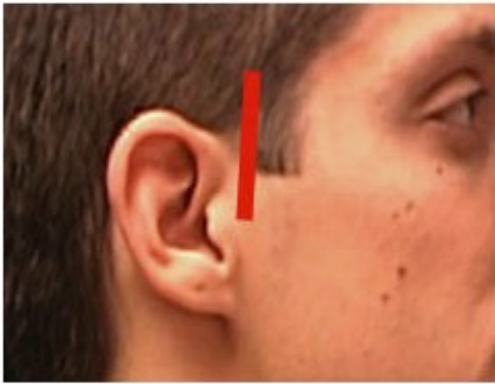




# Medical Gross Anatomy

## Surface Anatomy

### Surface Anatomy: Pulses



Superficial Temporal Artery



Carotid Artery



Brachial Artery



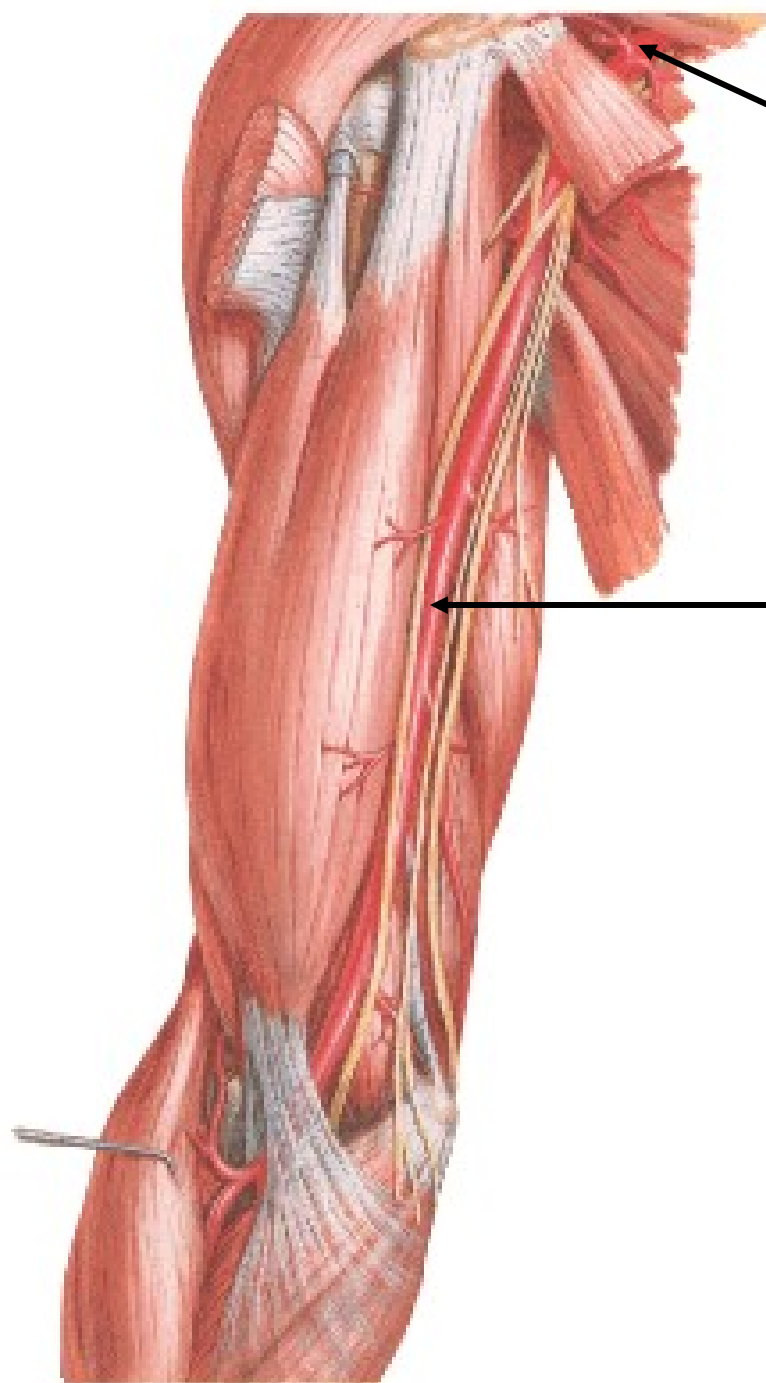
Radial Artery



Femoral Artery

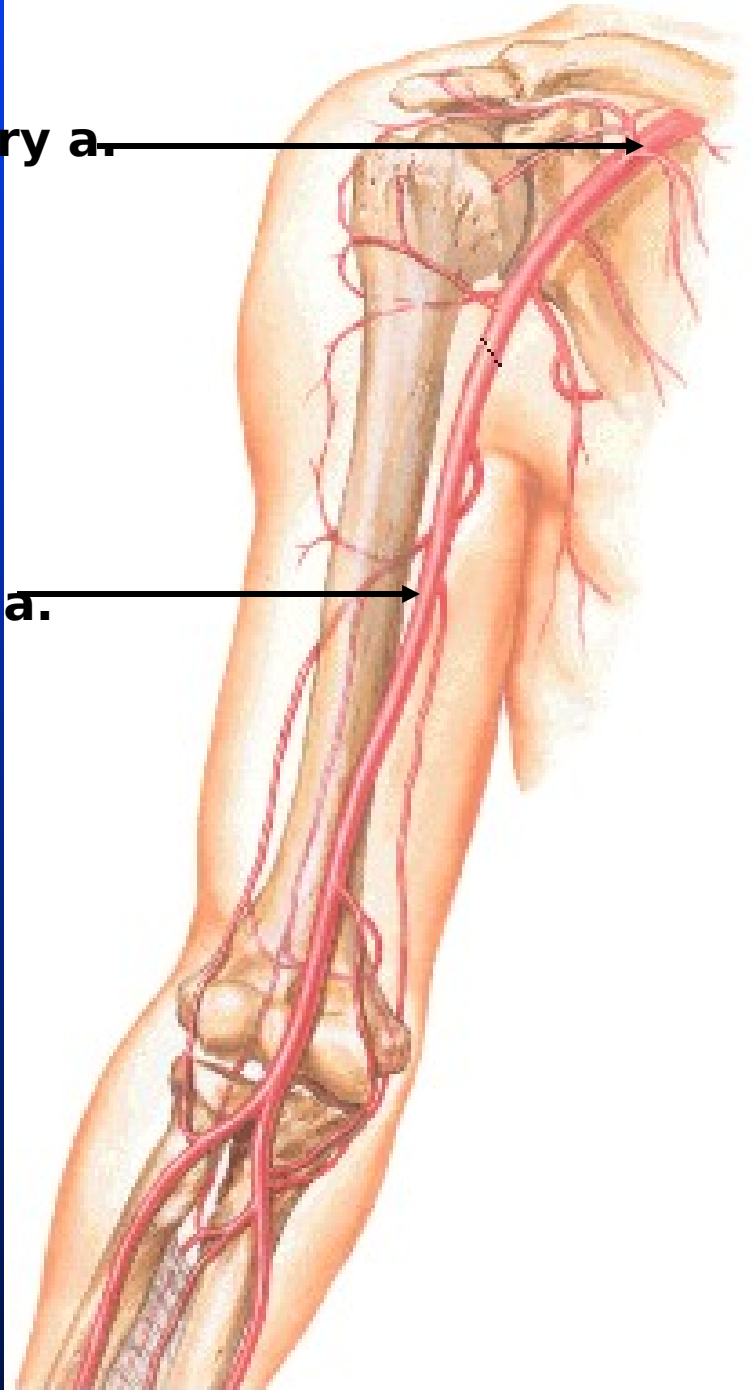


Popliteal Artery



**Axillary a.**

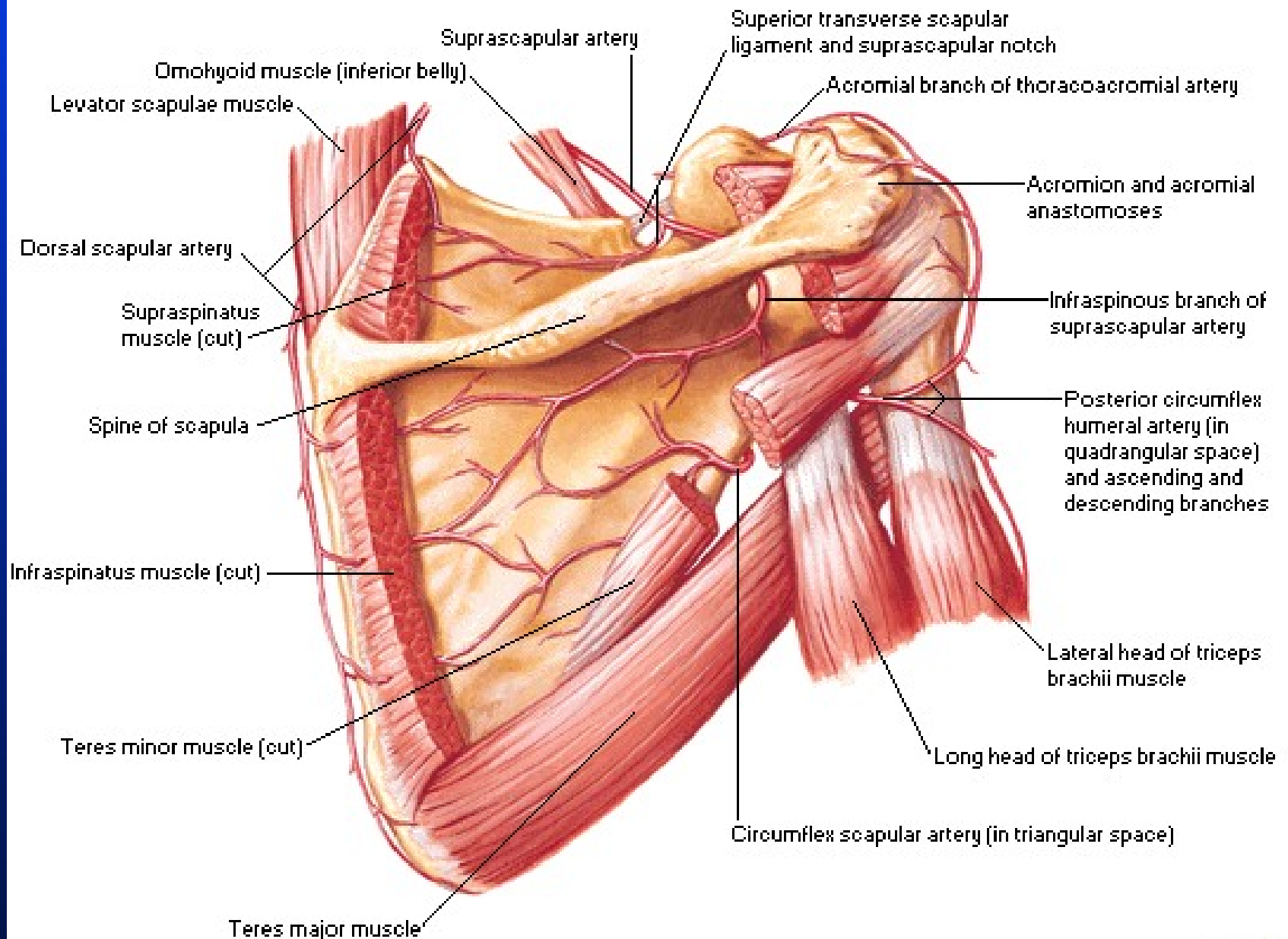
**Brachial a.**

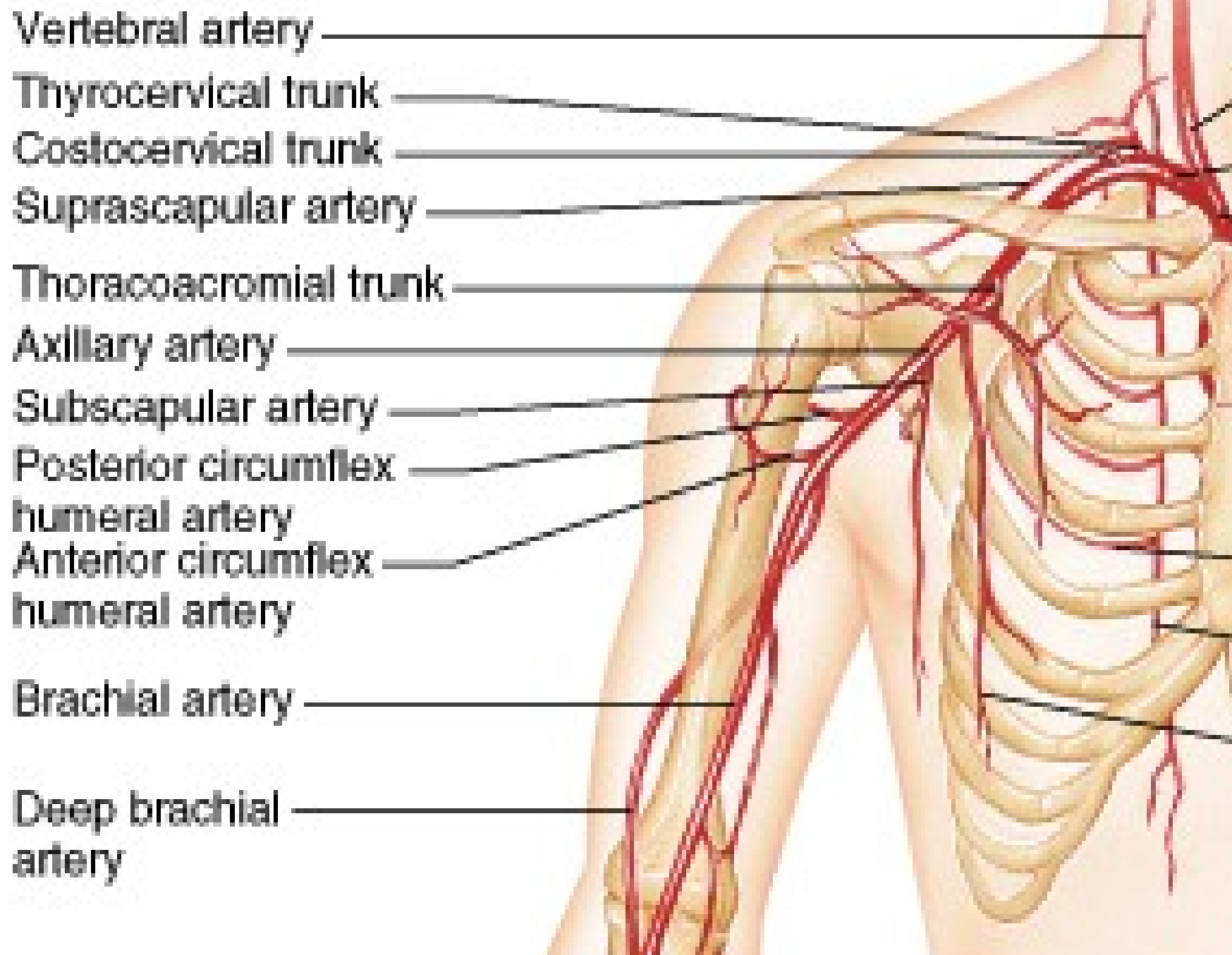




# Axillary Artery and Anastomoses Around Scapula

## Posterior View

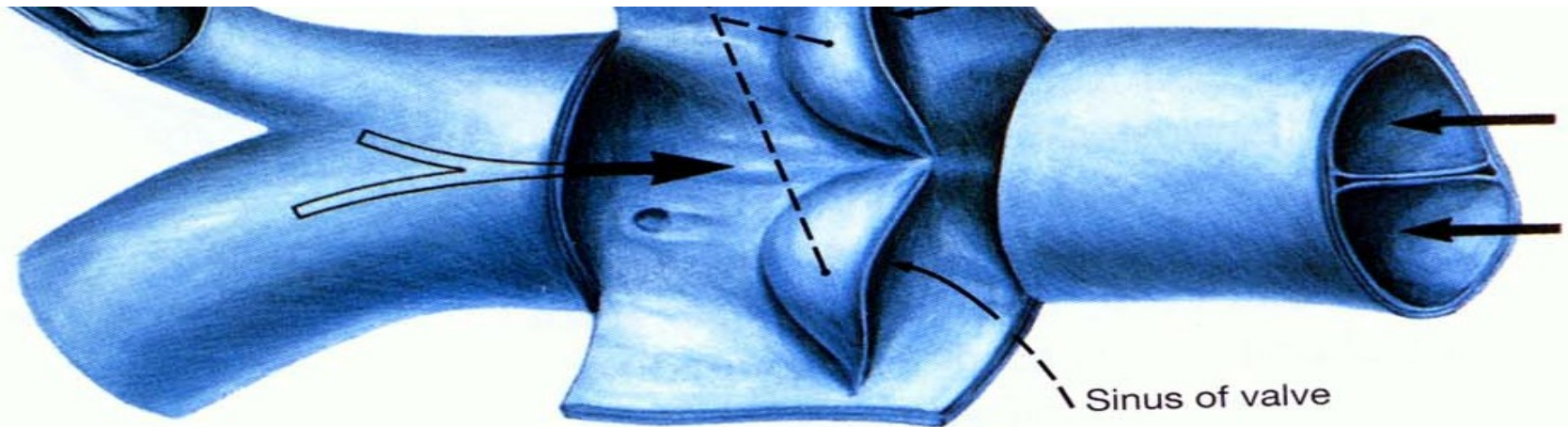




# VEINS

# Valves Visible in an Opened Segment of Vein

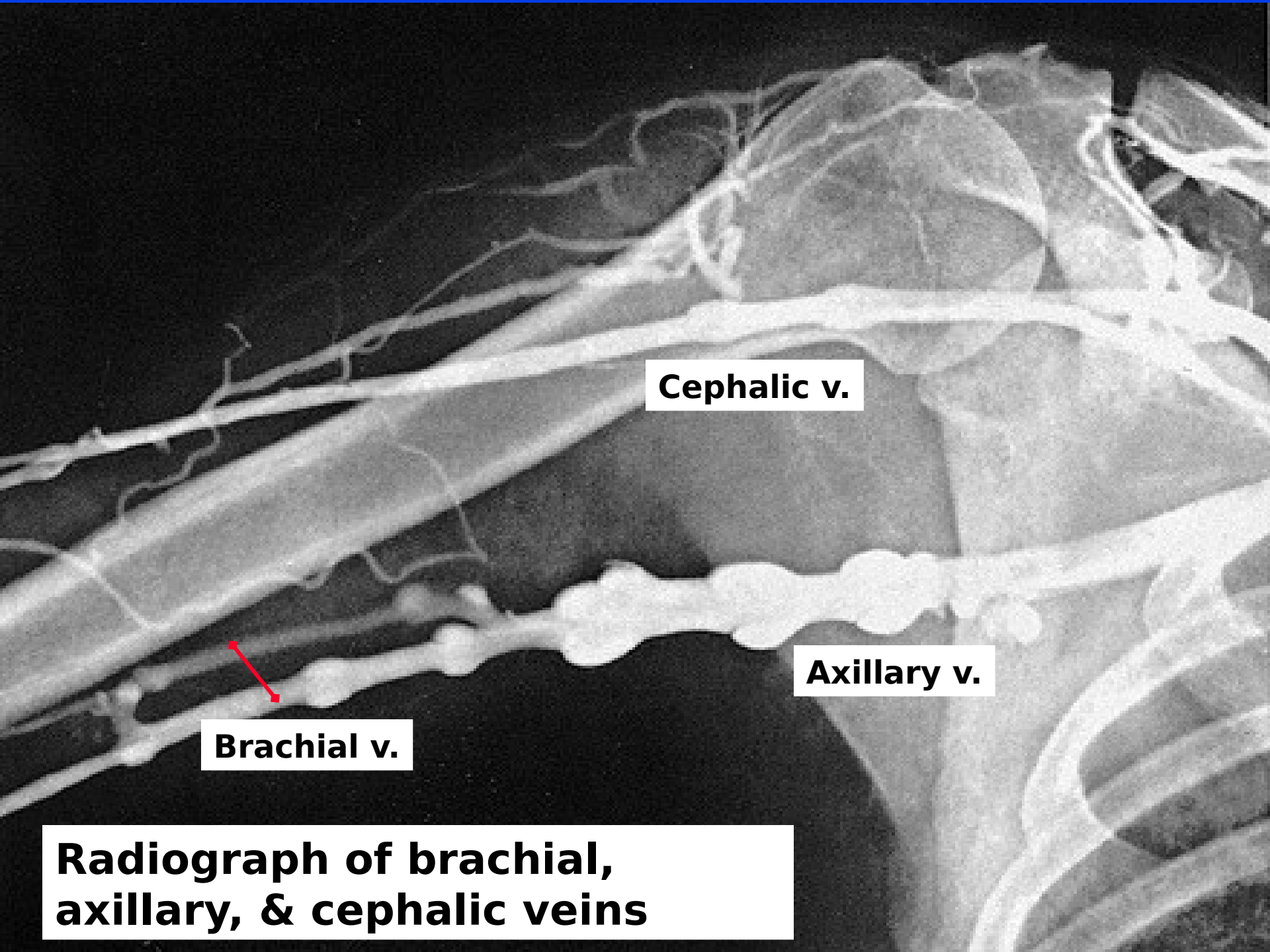
- Venous valves are bicuspid semilunar folds.



Figs. 24, 25

# Valves Visible in an Opened Segment of Vein

- In the following figure, normal blood flow is from left to right.
- Reversed blood flow closes the valve because blood becomes trapped in the sinuses.
- Incompetent valves are the cause of **varicose veins**.



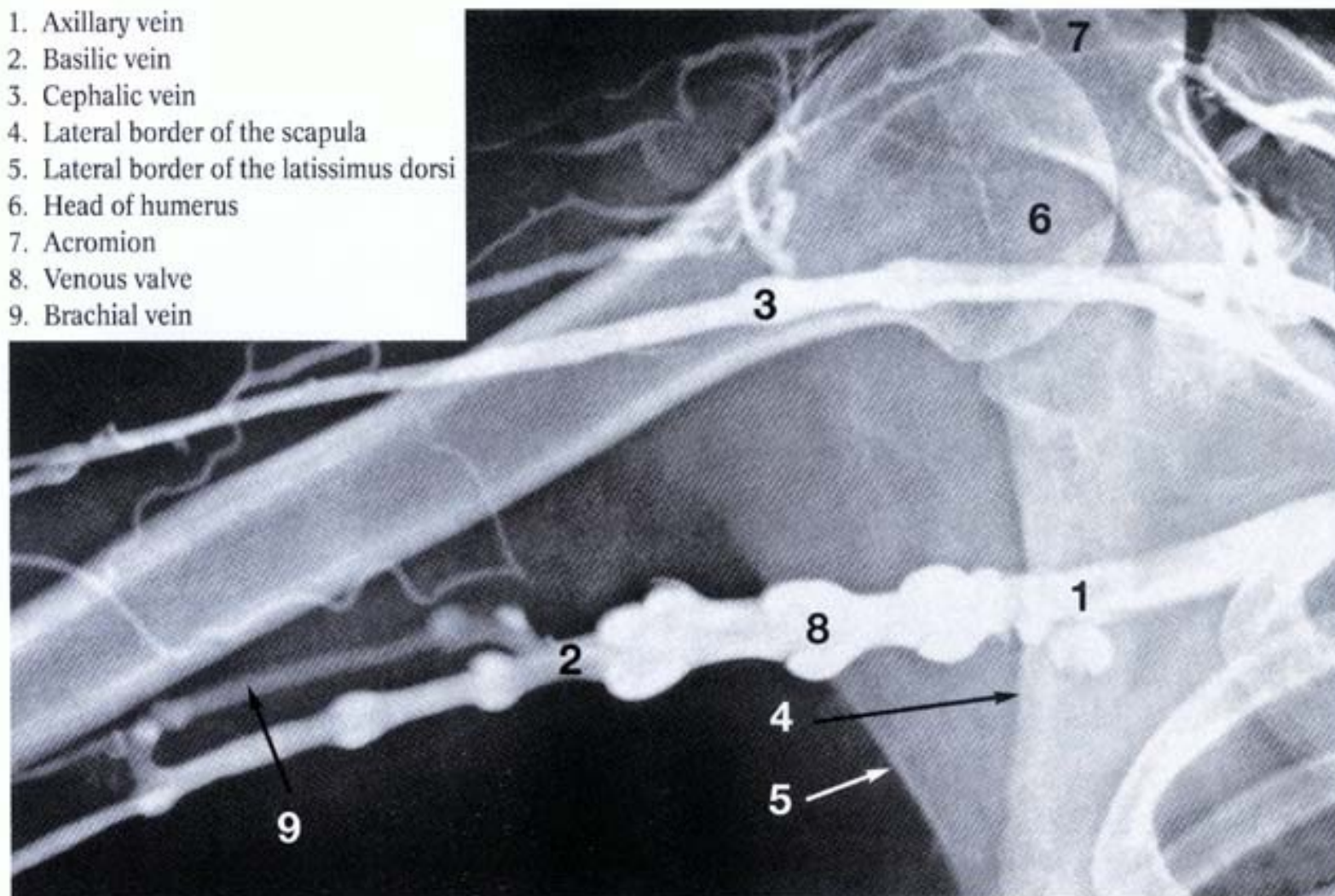
**Cephalic v.**

**Axillary v.**

**Brachial v.**

**Radiograph of brachial,  
axillary, & cephalic veins**

1. Axillary vein
2. Basilic vein
3. Cephalic vein
4. Lateral border of the scapula
5. Lateral border of the latissimus dorsi
6. Head of humerus
7. Acromion
8. Venous valve
9. Brachial vein



**Fig. 22: Radiograph of Veins in the Axillary Region**

NOTE: 1) the basilic vein (2) becomes the axillary vein (1).

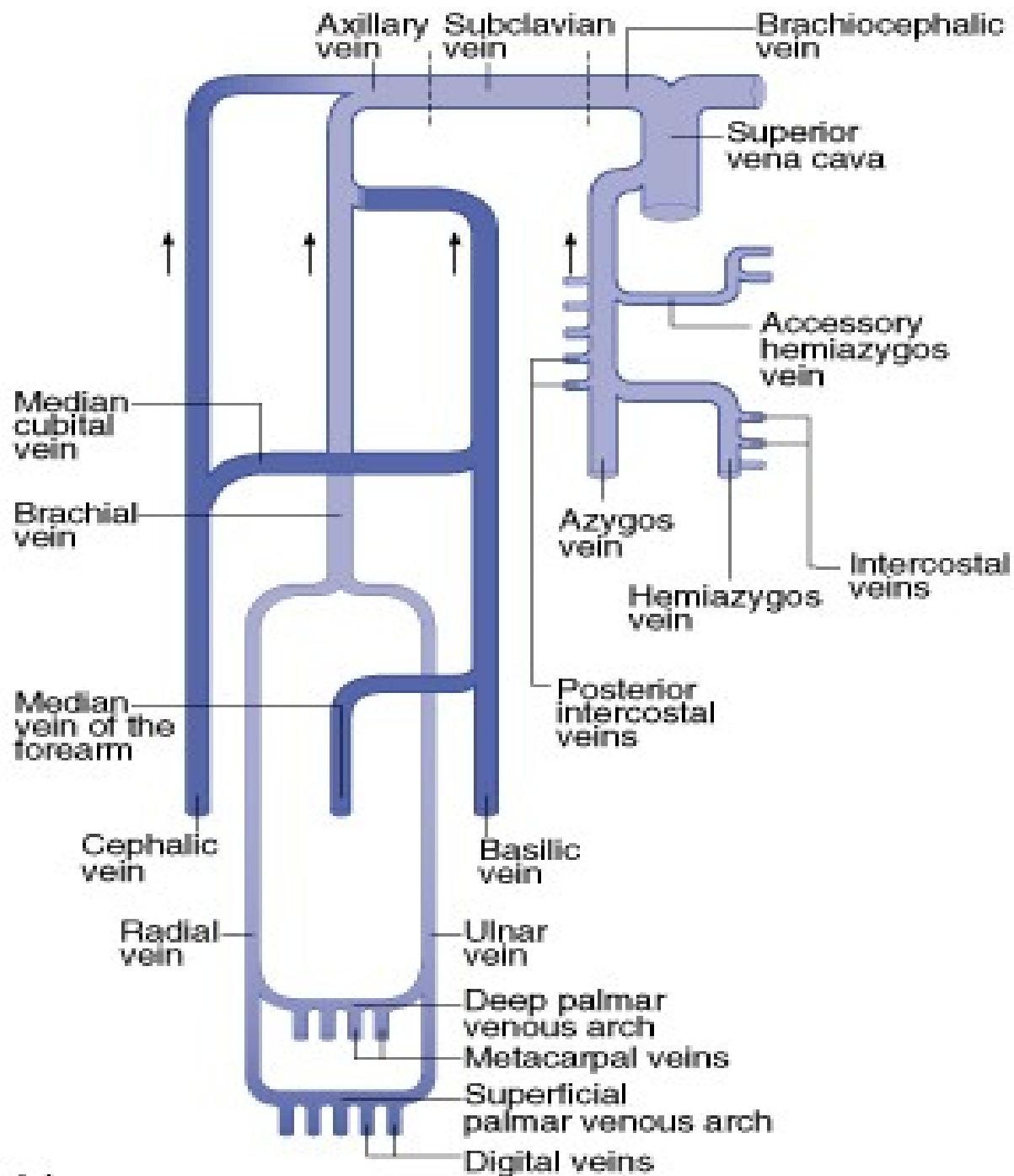
2) one of the brachial veins (9) also flows into the axillary vein as does the cephalic vein (3), the junction of which is medial to the field shown here.

3) the venous valves (8) along the course of the axillary vein. These are shown schematically in Figure 25.



# **VEINS OF THE ARM**

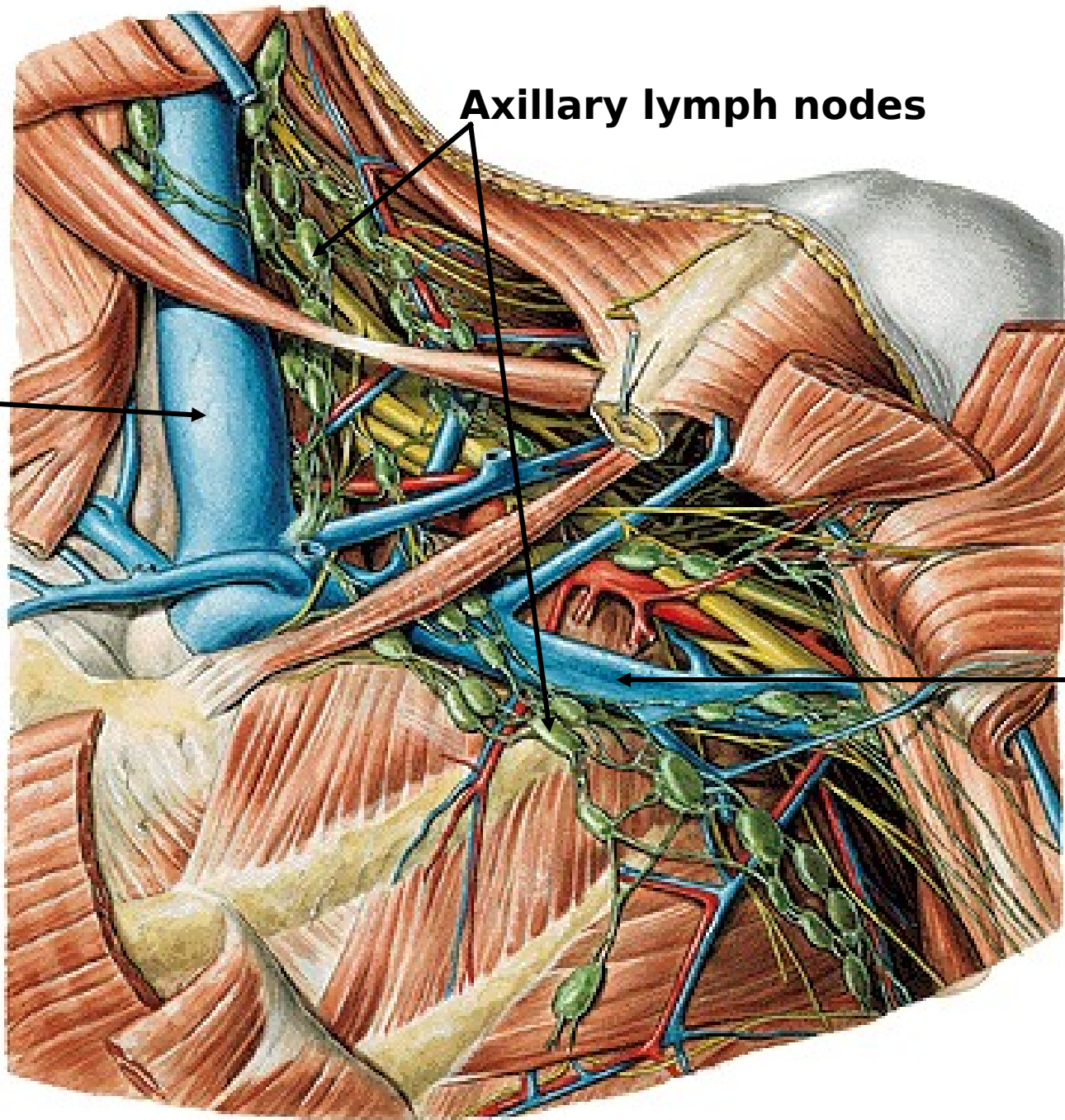
- **Subclavian vein**
- **Axillary vein**
- **Brachial vein**
- **Cephalic vein**
- **Basilic vein**
- **Median cubical vein**



**Jugular v.**

**Axillary lymph nodes**

**Axillary v.**



Right subclavian vein

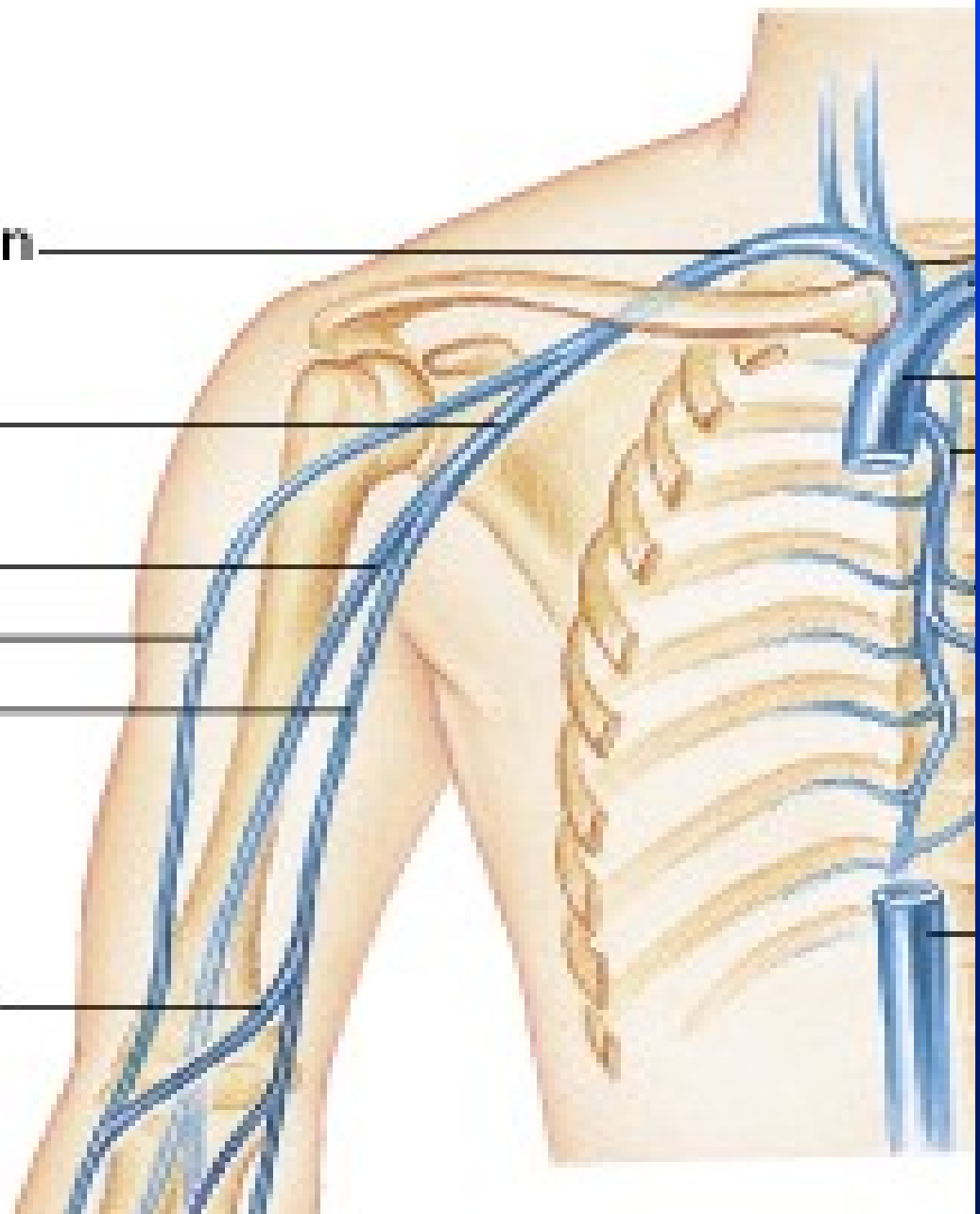
Axillary vein

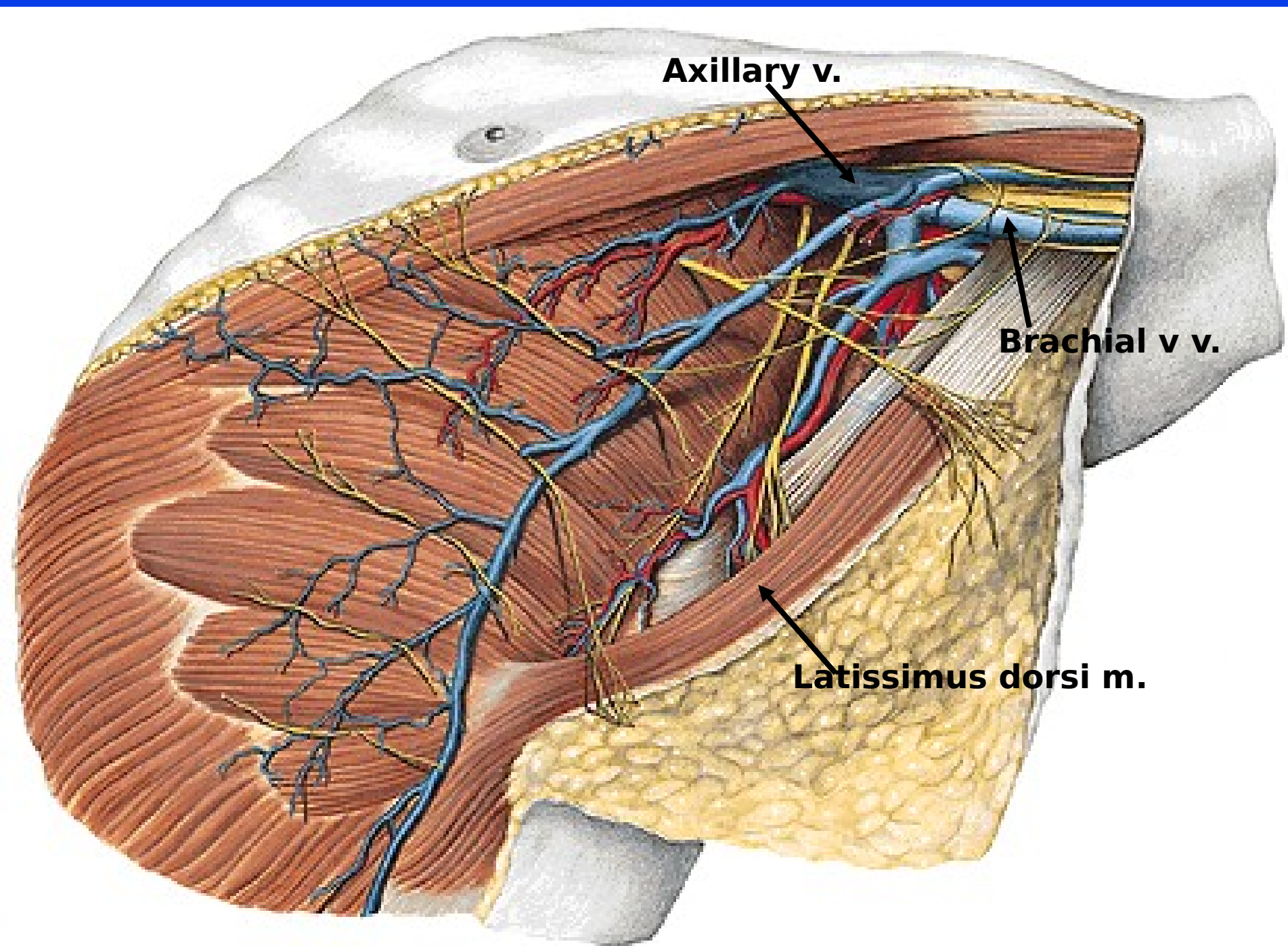
Brachial vein

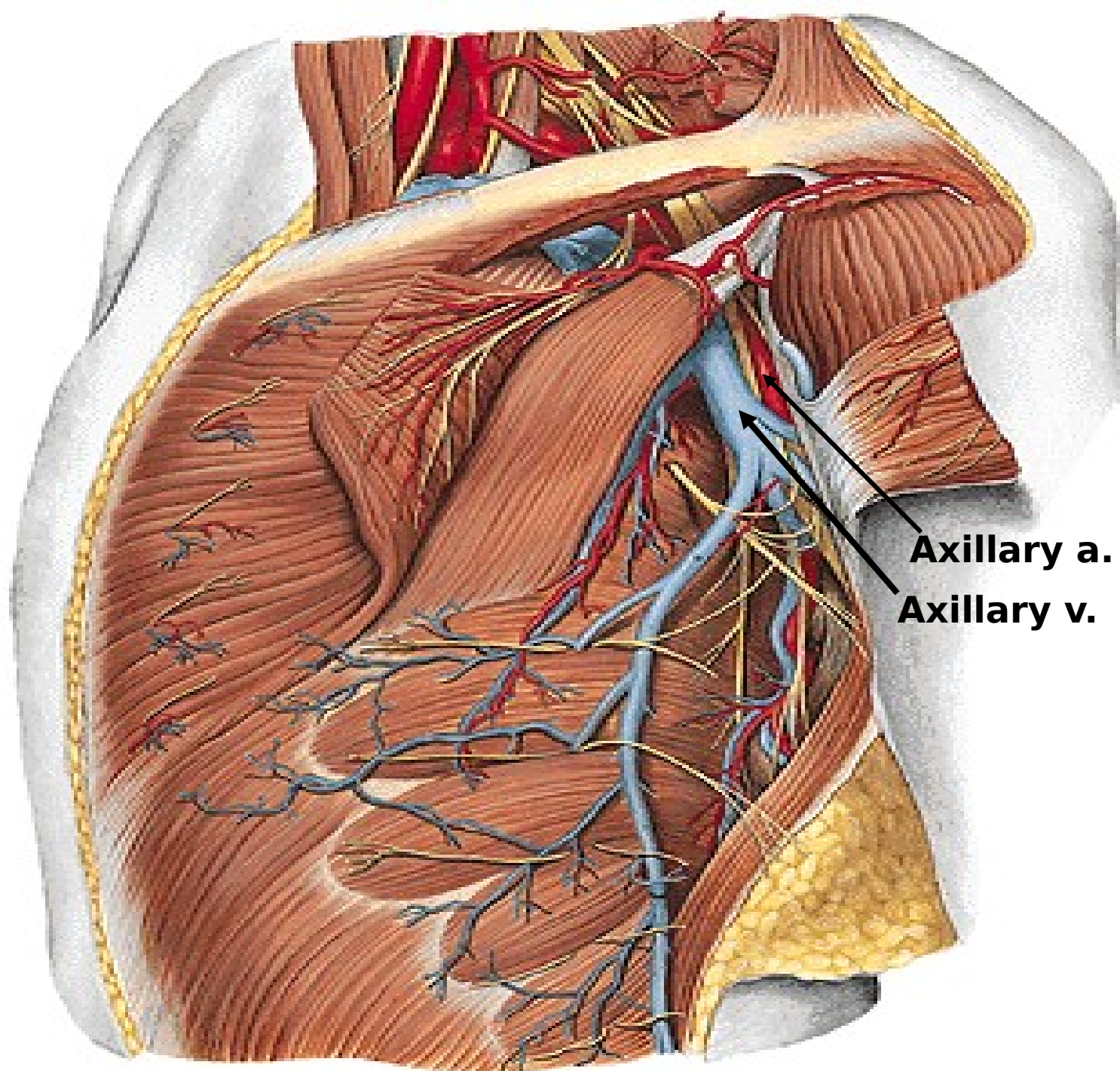
Cephalic vein

Basilic vein

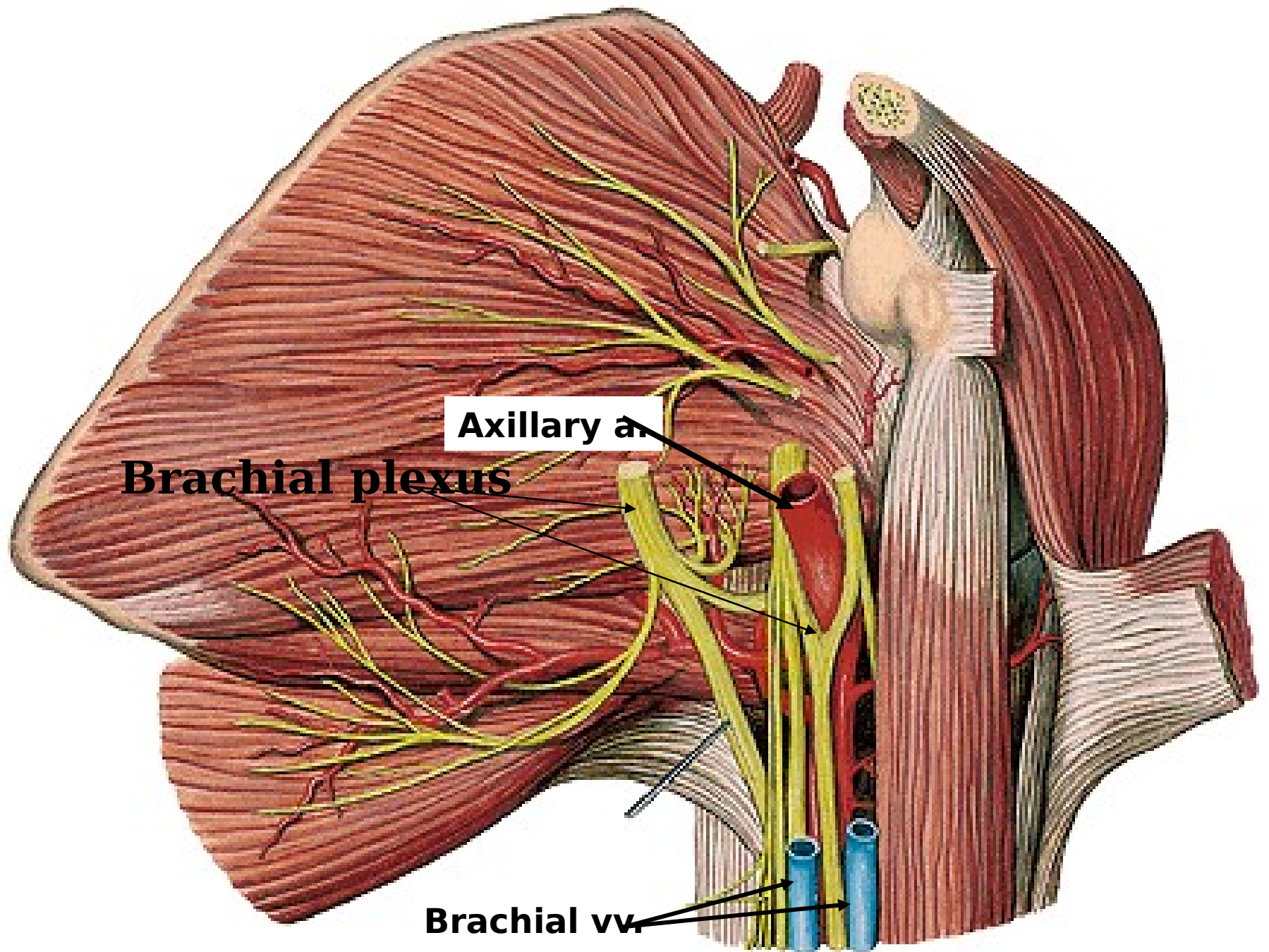
Median cubital vein



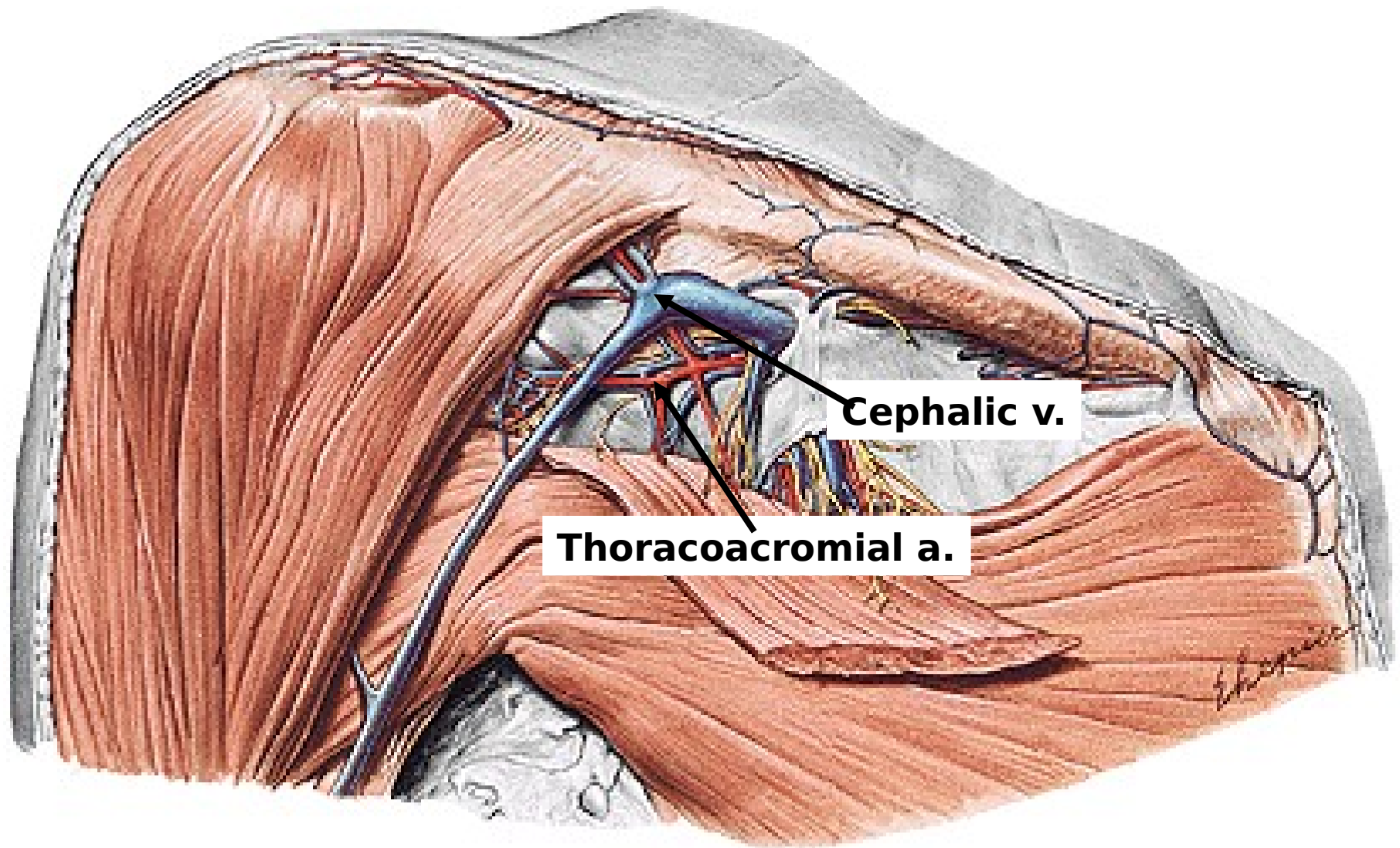


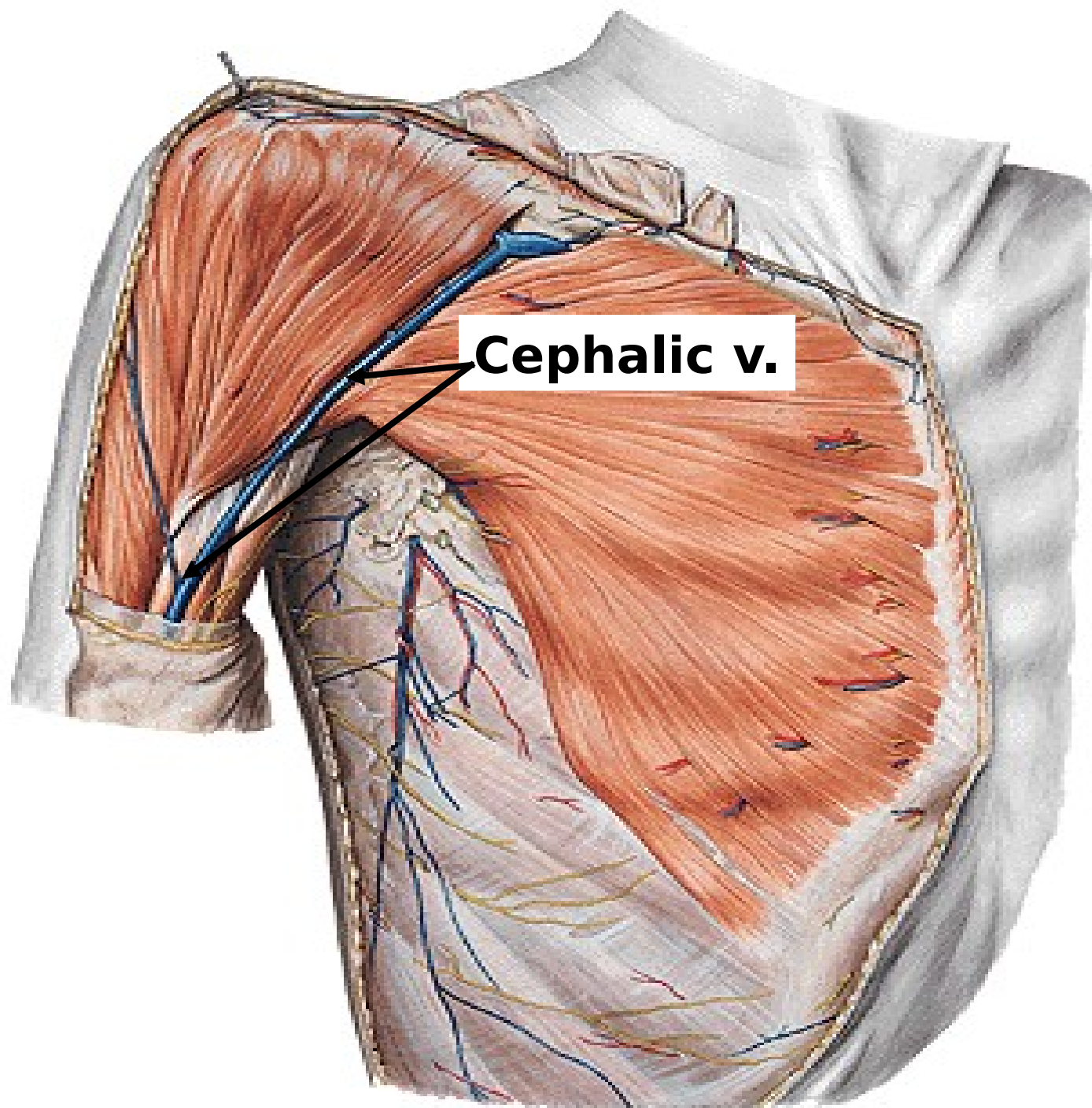


**Axillary a.**  
**Axillary v.**







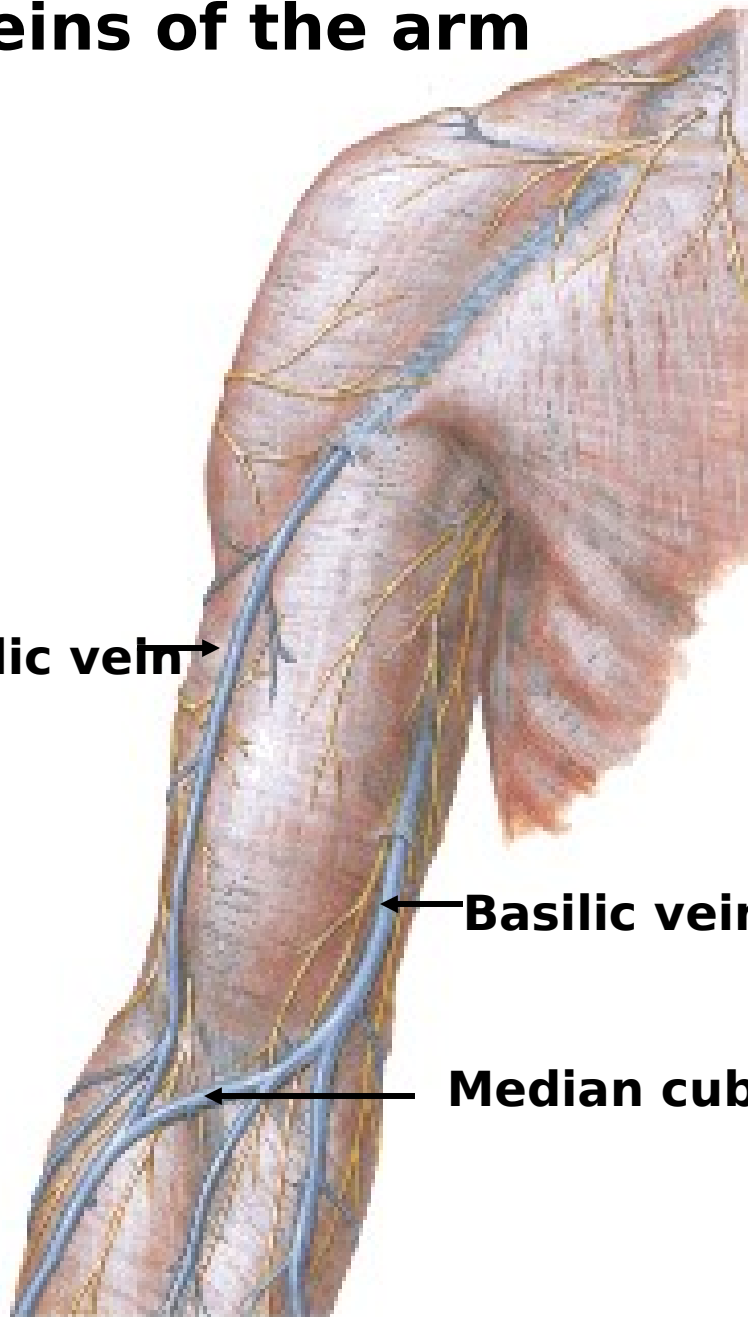


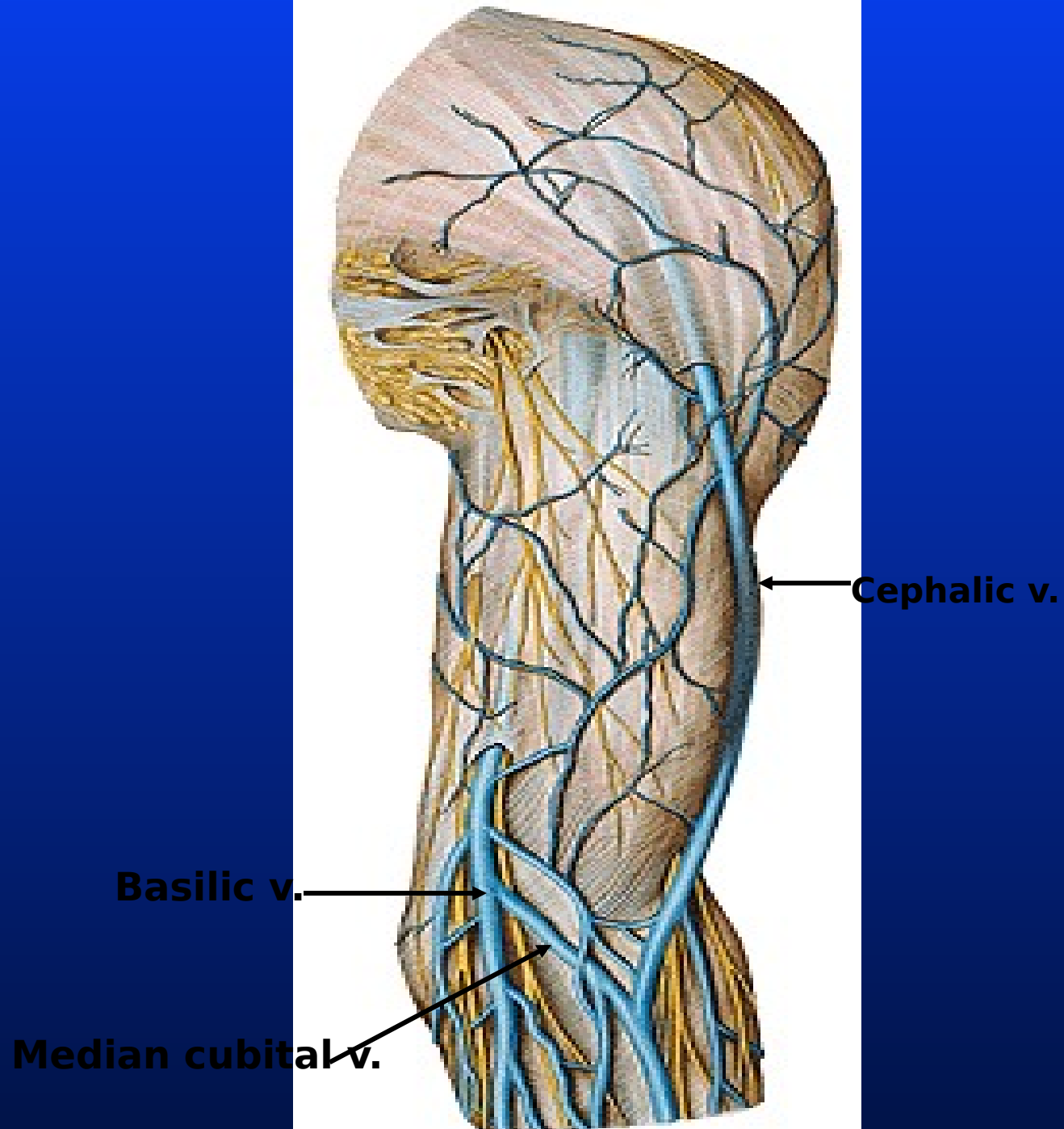
# Superficial veins of the arm

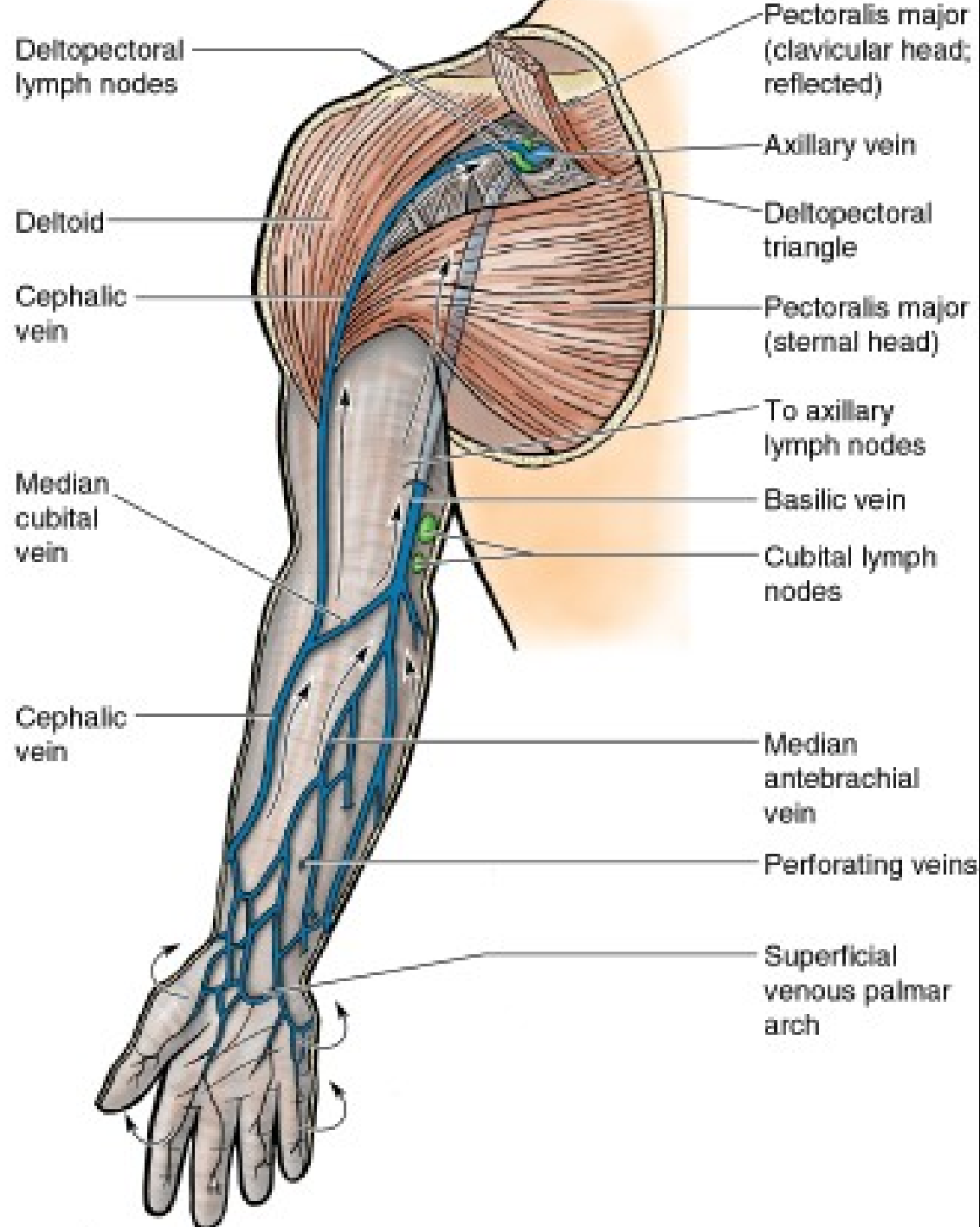
**Cephalic vein** →

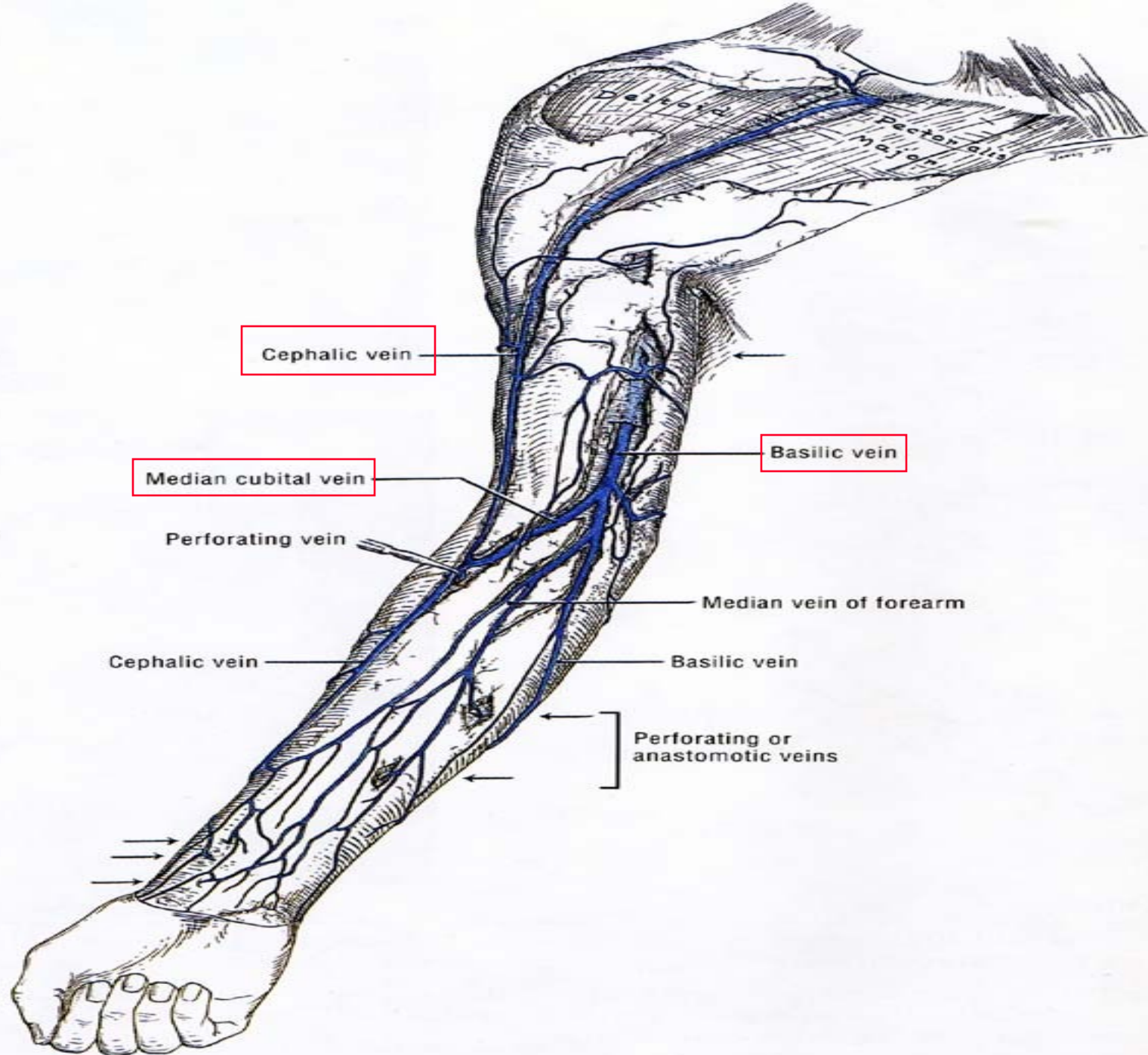
← **Basilic vein**

← **Median cubical vein**









# **NERVES OF THE UPPER LIMB**



# Nerves of the Upper Limb

- Most cutaneous nerves of the upper limb are derived from the **brachial plexus** - a major nerve network formed by the ventral rami of the 5th C to 1st T spinal nerves
- The nerves to the shoulder, however, are derived from the **cervical plexus** - first 4 C

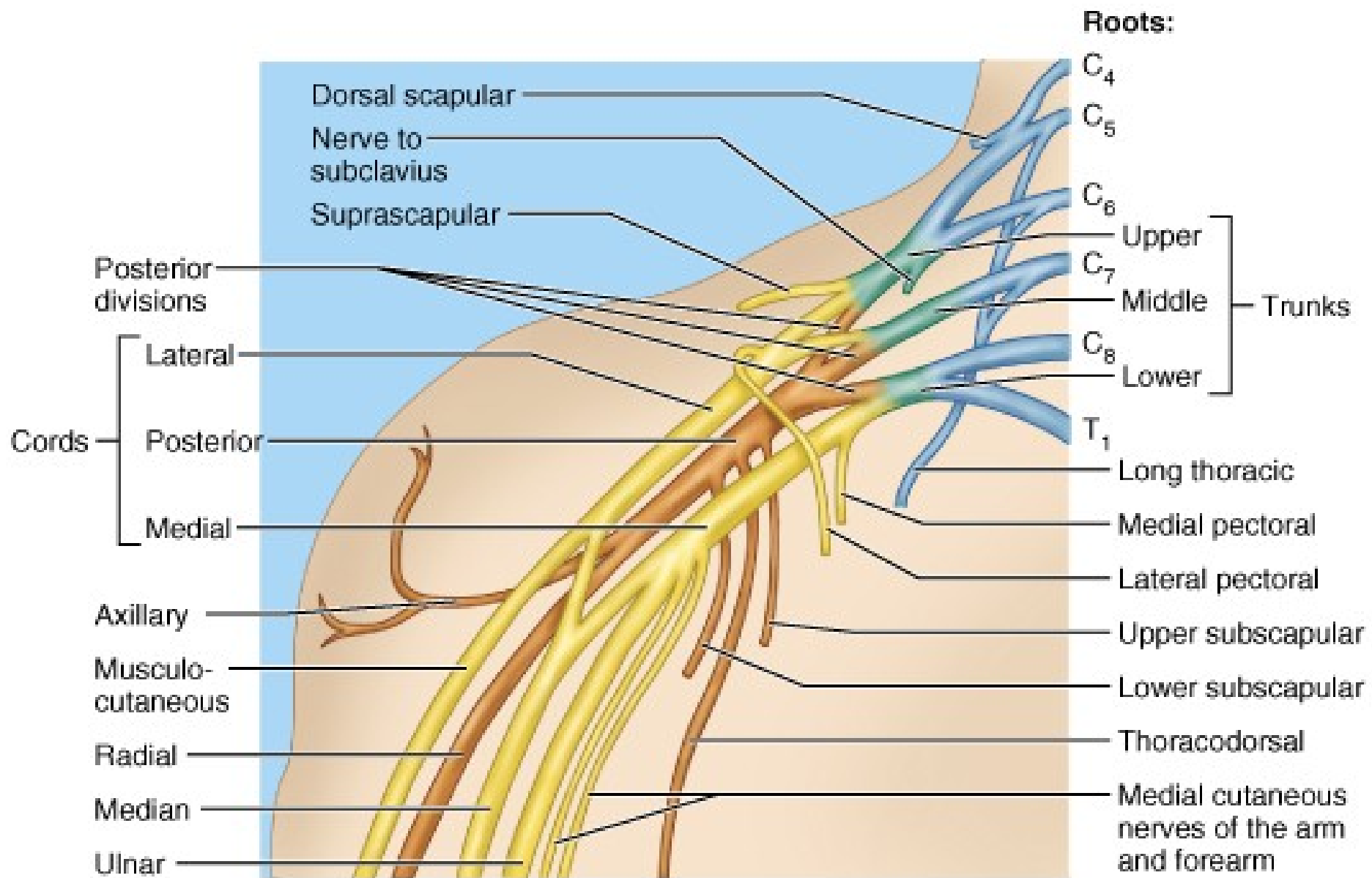
# BRACHIAL PLEXUS

- Source of nerves that innervate the tissues of the upper limb; from spinal cord levels (C<sub>5</sub> - T<sub>1</sub>)

**Table 6.4. (Continued) Brachial Plexus and Nerves of the Upper Limb**

Nerve	Origin	Course	Distribution
<b>Intraclavicular branches</b>			
Lateral pectoral	Lateral cord, receiving fibers from C5–C7	Pierces clavipectoral fascia to reach deep surface of pectoral muscles	Primarily supplies pectoralis major but sends a loop to medial pectoral nerve that innervates pectoralis minor
Musculocutaneous	Lateral cord, receiving fibers from C5–C7	Enters deep surface of coraco-brachialis and descends between biceps brachii and brachialis	Innervates coracobrachialis, biceps brachii, and brachialis; continues as lateral antebrachial cutaneous nerve
Median	Lateral root is a continuation of lateral cord, receiving fibers from C6 and C7; medial root is a continuation of medial cord receiving fibers from C8 and T1	Lateral root joins medial root to form median nerve lateral to axillary artery	Innervates flexor muscles in forearm (except flexor carpi ulnaris, ulnar half of flexor digitorum profundus) and five hand muscles
Medial pectoral	Medial cord, receiving fibers from C8 and T1	Passes between axillary artery and vein and enters deep surface of pectoralis minor	Innervates the pectoralis minor and part of pectoralis major
Medial brachial cutaneous	Medial cord, receiving fibers from C8 and T1	Runs along the medial side of axillary vein and communicates with intercostobrachial nerve	Supplies skin on medial side of arm
Medial antebrachial cutaneous	Medial cord, receiving fibers from C8 and T1	Runs between axillary artery and vein	Supplies skin over medial side of forearm
Ulnar	A terminal branch of medial cord, receiving fibers from C8 and T1 and often C7	Passes down medial aspect of arm and runs posterior to medial epicondyle to enter forearm	Innervates one and one-half flexor muscles in forearm, most small muscles in hand, and skin of hand medial to a line bisecting 4th digit (ring finger)
Upper subscapular	Branch of posterior cord, receiving fibers from C5 and C6	Passes posteriorly and enters subscapularis	Innervates superior portion of subscapularis
Thoracodorsal	Branch of posterior cord, receiving fibers from C5–C8	Arises between upper and lower subscapular nerves and runs inferolaterally along posterior axillary wall to latissimus dorsi	Innervates latissimus dorsi
Lower subscapular	Branch of posterior cord, receiving fibers from C5 and C6	Passes inferolaterally, deep to subscapular artery and vein, to subscapularis and teres major	Innervates inferior portion of subscapularis and teres major
Axillary	Terminal branch of posterior cord, receiving fibers from C5 and C6	Passes to posterior aspect of arm through quadrangular space <sup>a</sup> in company with posterior circumflex humeral artery and then winds around surgical neck of humerus; gives rise to lateral brachial cutaneous nerve	Innervates teres minor and deltoid, shoulder joint, and skin over inferior part of deltoid
Radial	Terminal branch of posterior cord, receiving fibers from C5–C8 and T1	Descends posterior to axillary artery; enters radial groove with deep brachial artery to pass between long and medial heads of triceps	Innervates triceps brachii, anconeus, brachioradialis, and extensor muscles of forearm; supplies skin on posterior aspect of arm and forearm via posterior cutaneous nerves of arm and forearm

<sup>a</sup> Quadrangular space is bounded superiorly by subscapularis and teres minor, inferiorly by teres major, medially by long head of triceps, and laterally by humerus.



(a)

**Key:**



= Roots



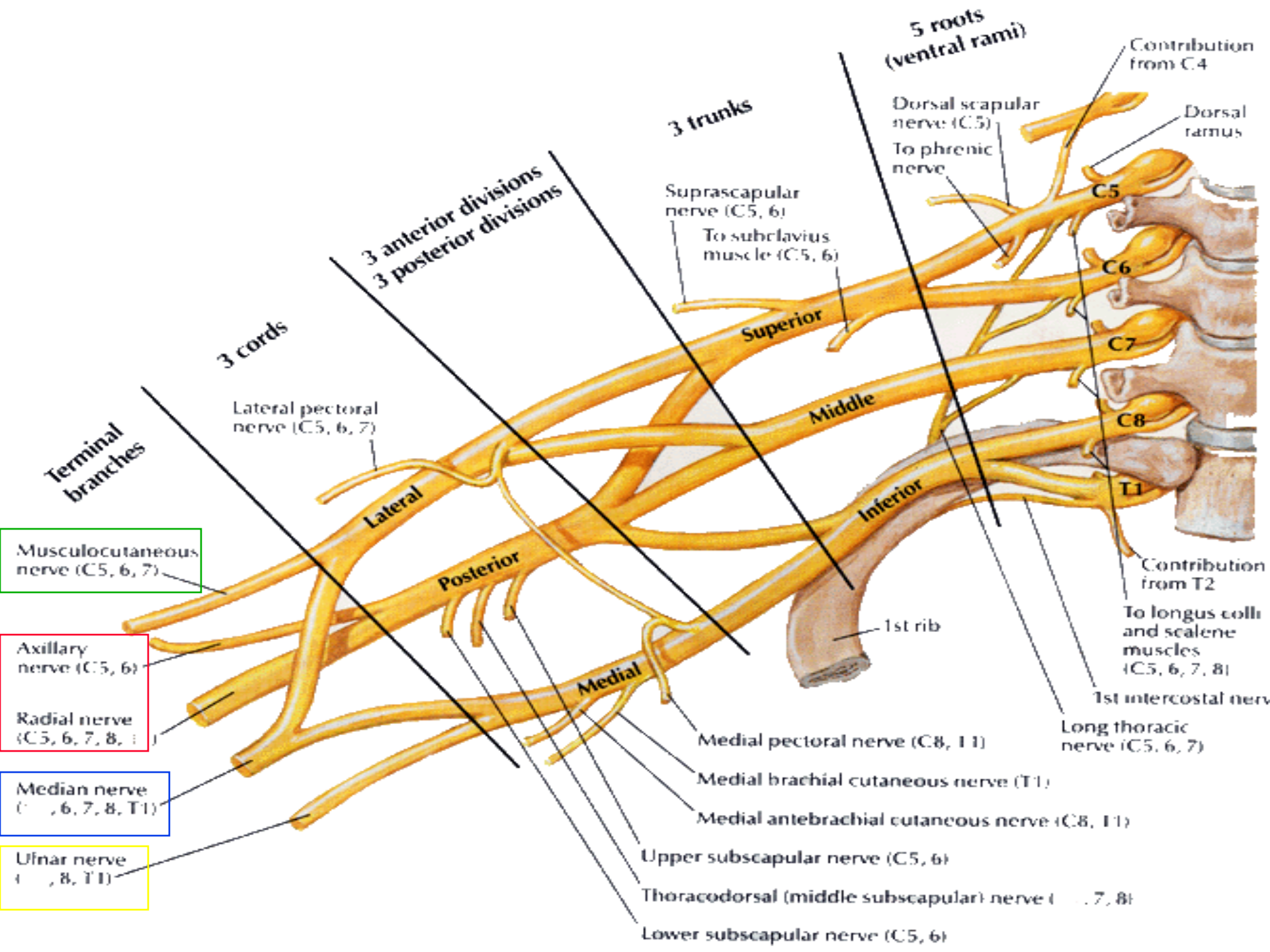
= Trunks



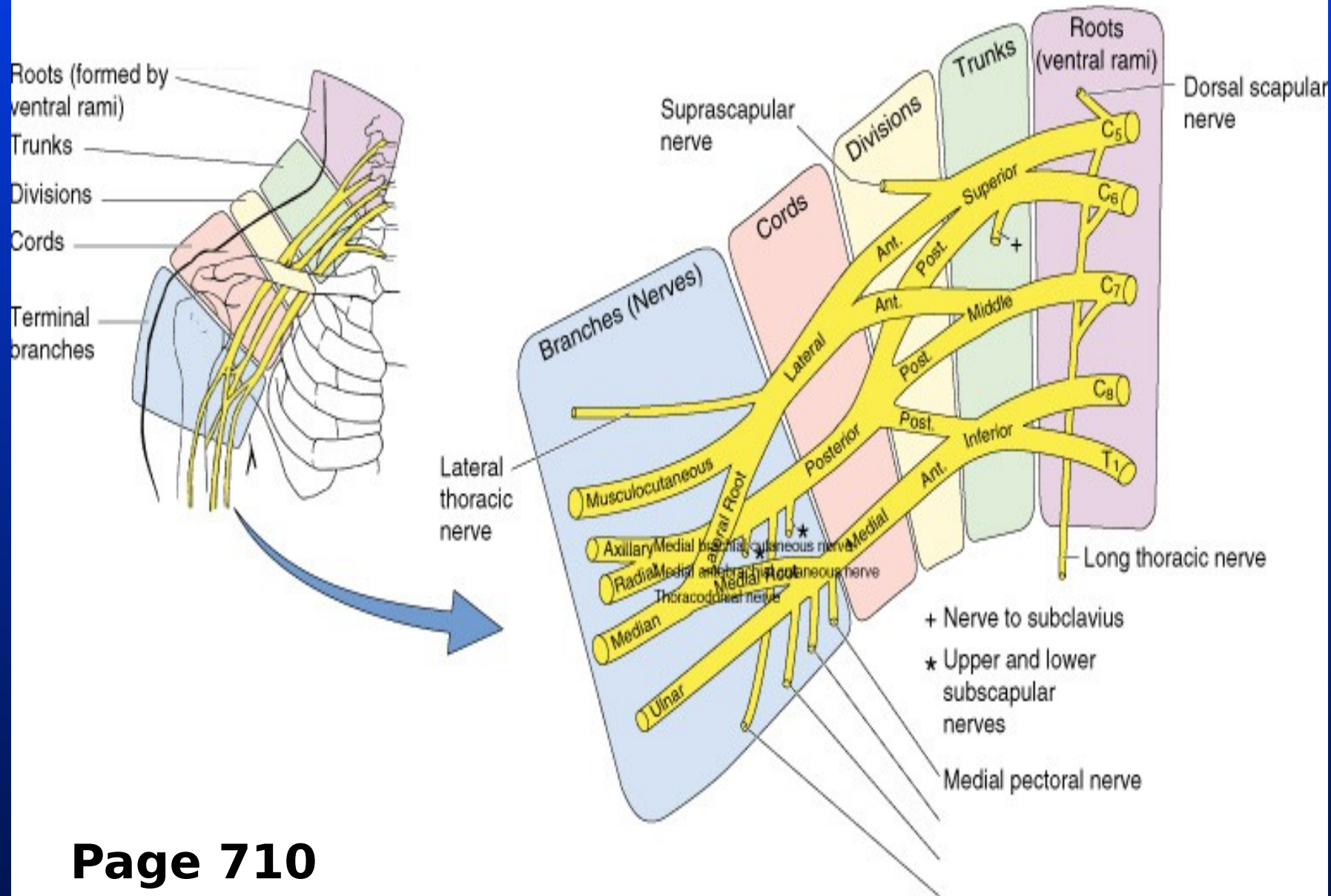
= Anterior division



= Posterior division



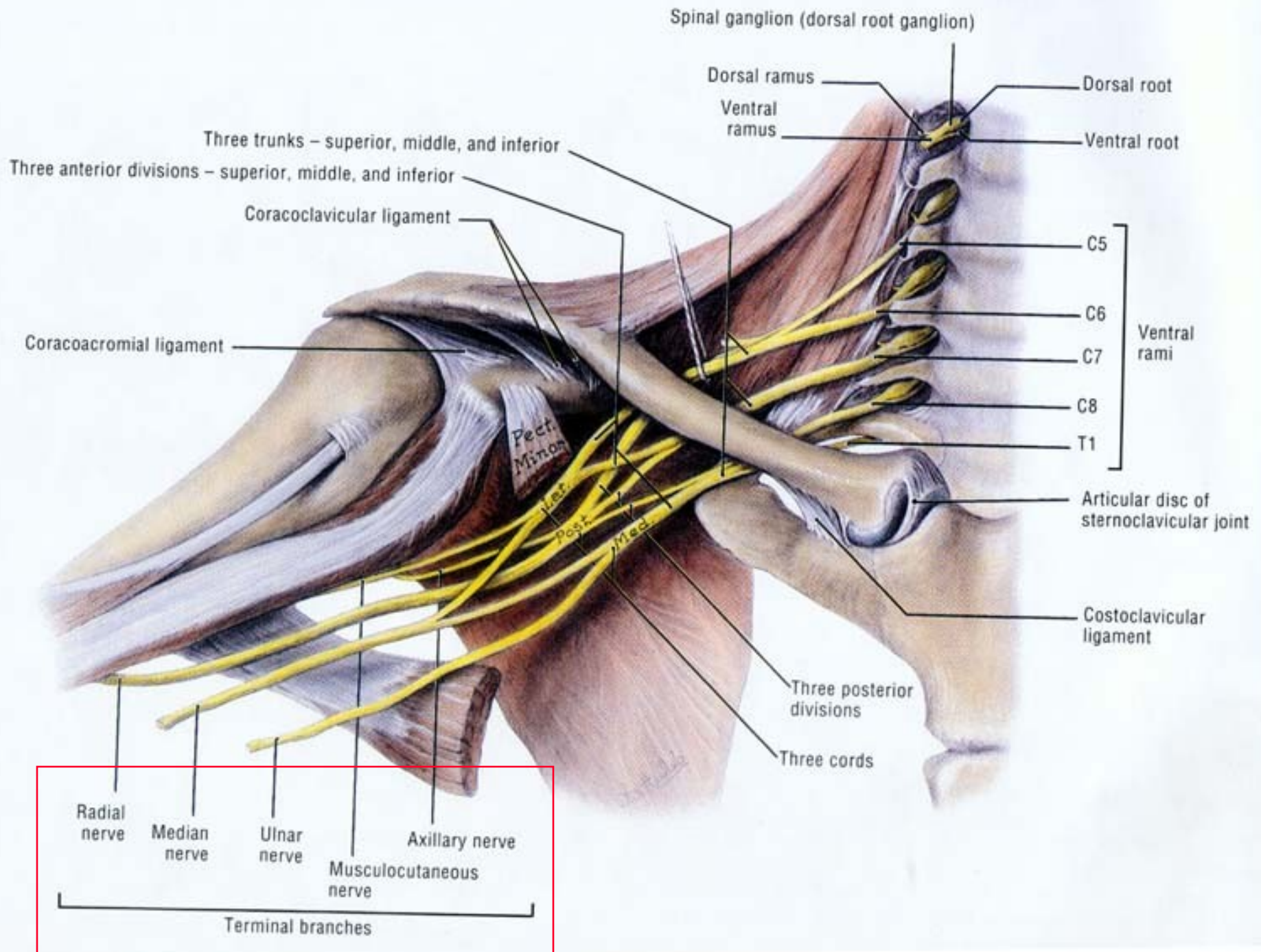
**Table 6.4. Brachial Plexus and Nerves of the Upper Limb**

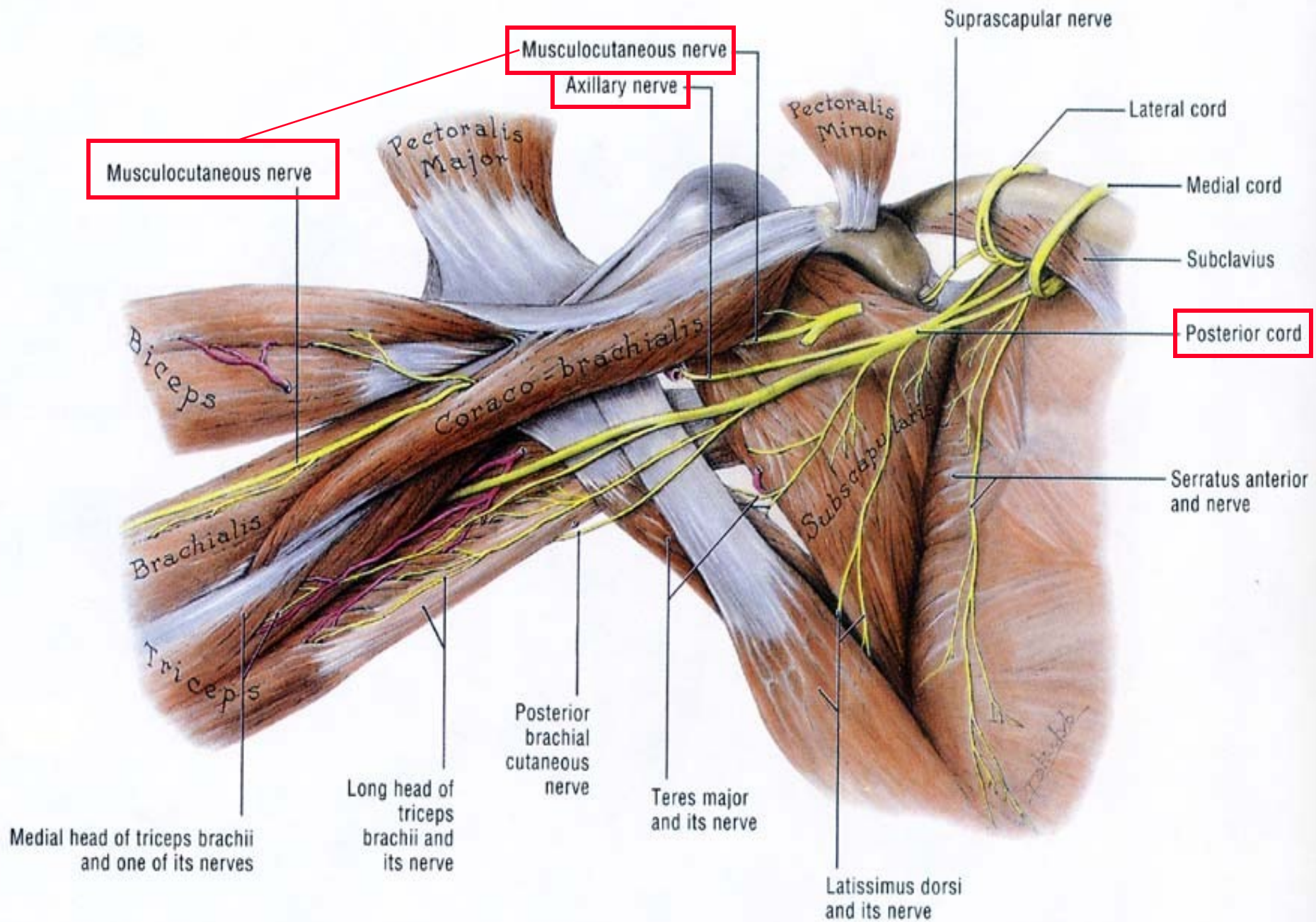




Major terminal branches (peripheral nerves)	Cords	Divisions	Trunks	Roots (ventral rami)
Musculocutaneous Median Ulnar Radial Axillary	Lateral Medial Posterior	Anterior Posterior Anterior Posterior Anterior Posterior	Upper Middle Lower	C <sub>5</sub> C <sub>6</sub> C <sub>7</sub> C <sub>8</sub> T <sub>1</sub>







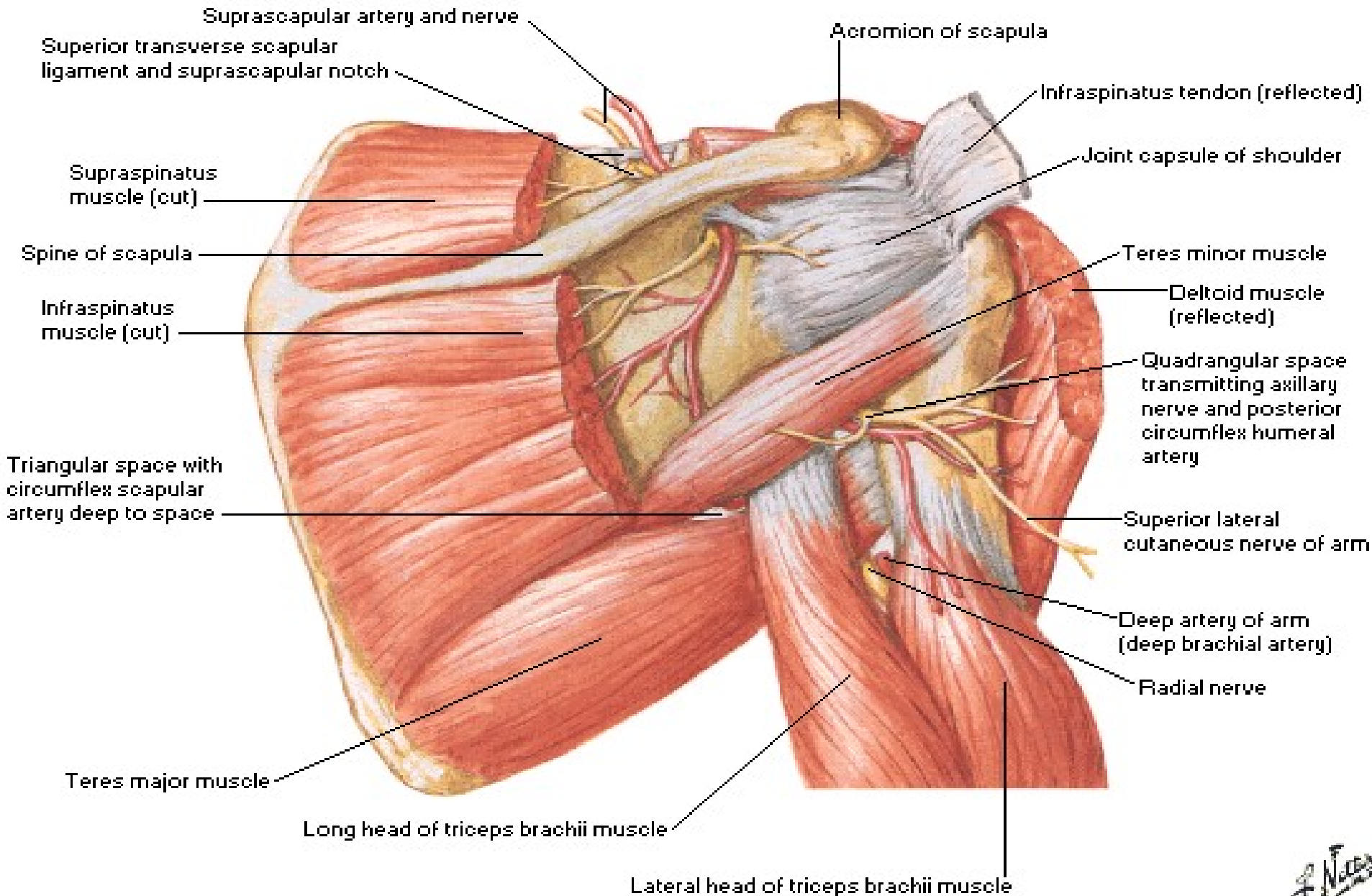
# INNERVATION OF JOINTS

- **Hilton's Law** - any nerve serving a muscle(s) producing movement at a joint also innervates the **joint** itself and the skin over it!



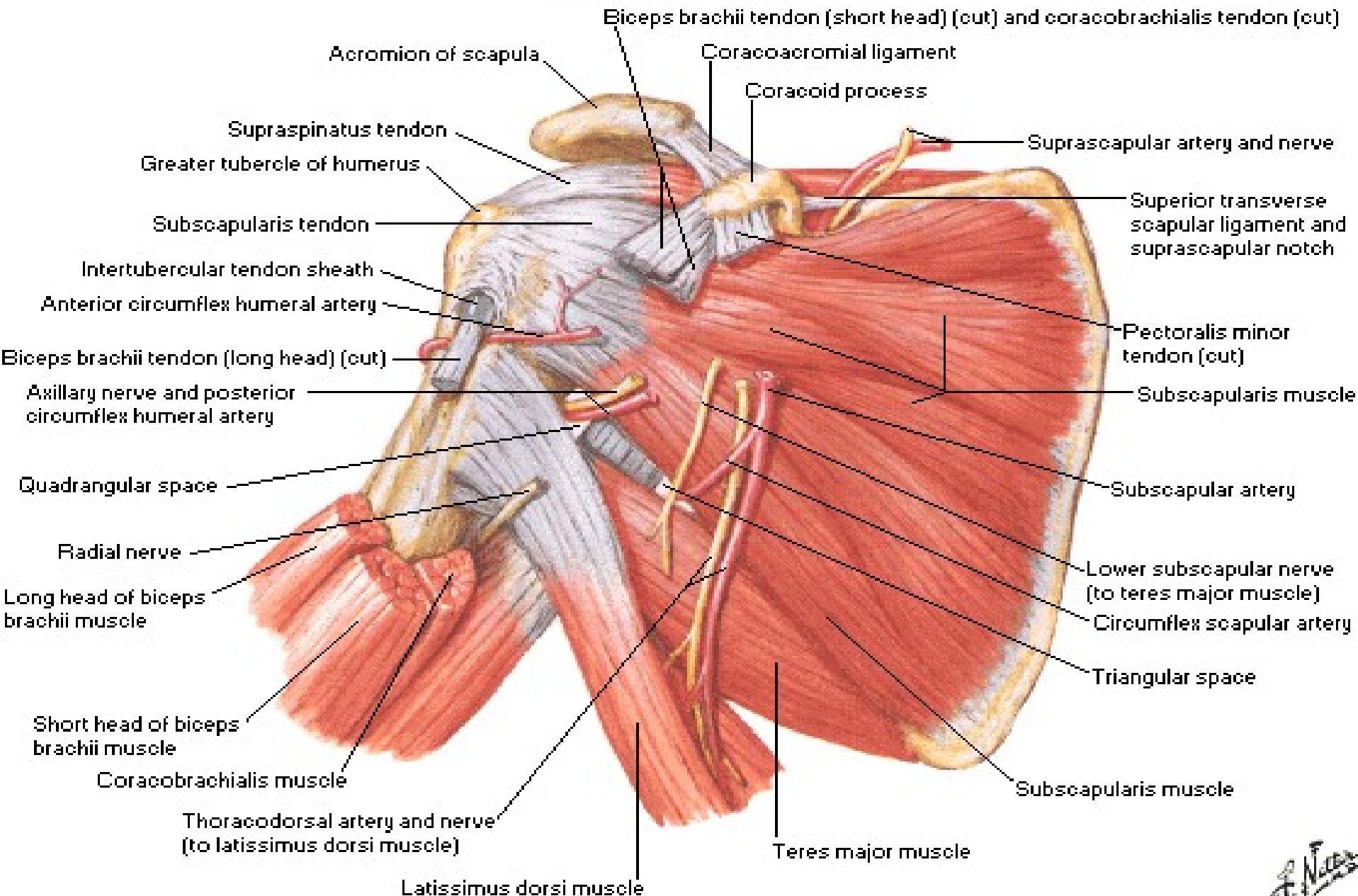
# Scapulohumeral Dissection

## Posterior View



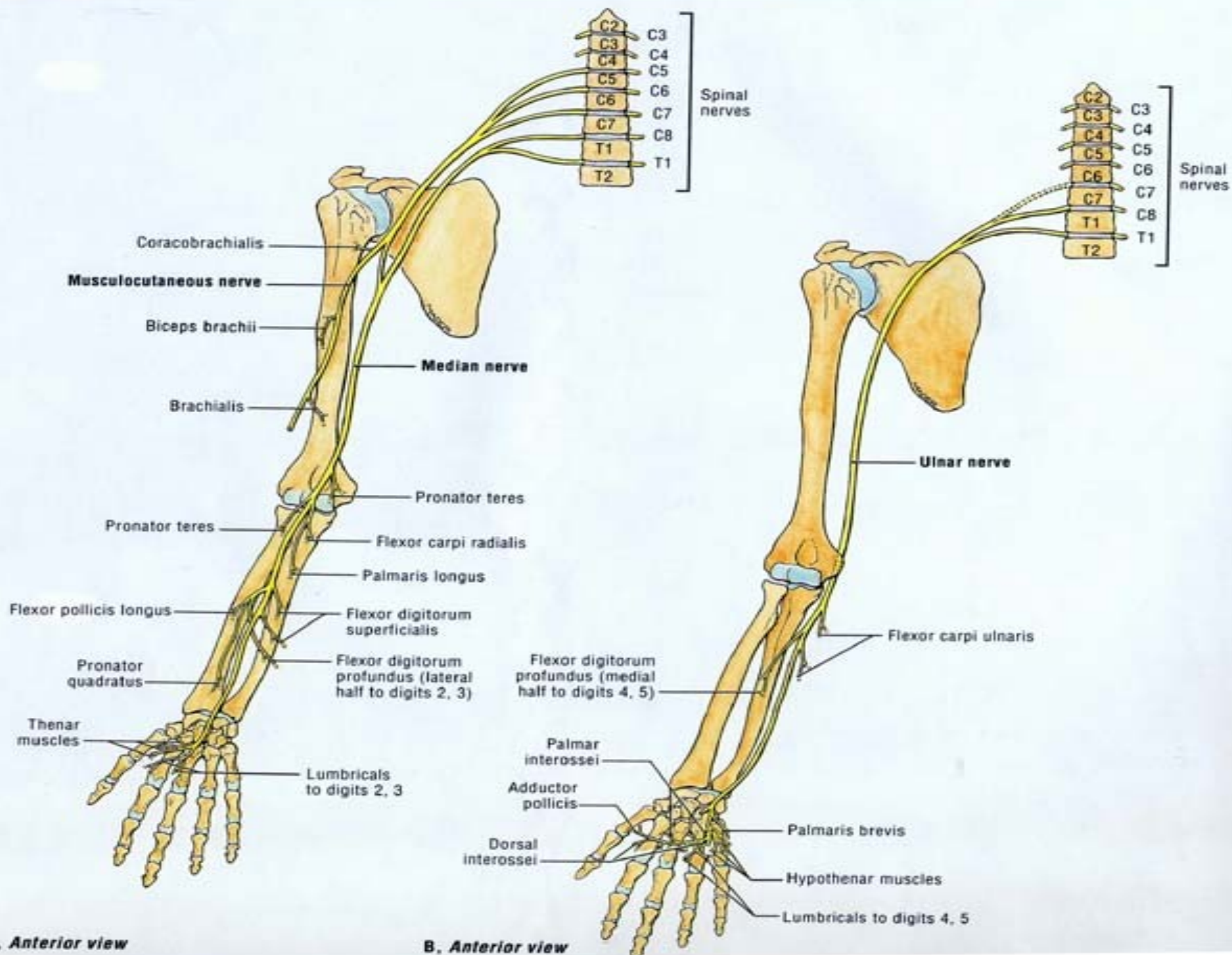
### Anterior View

### Anterior View

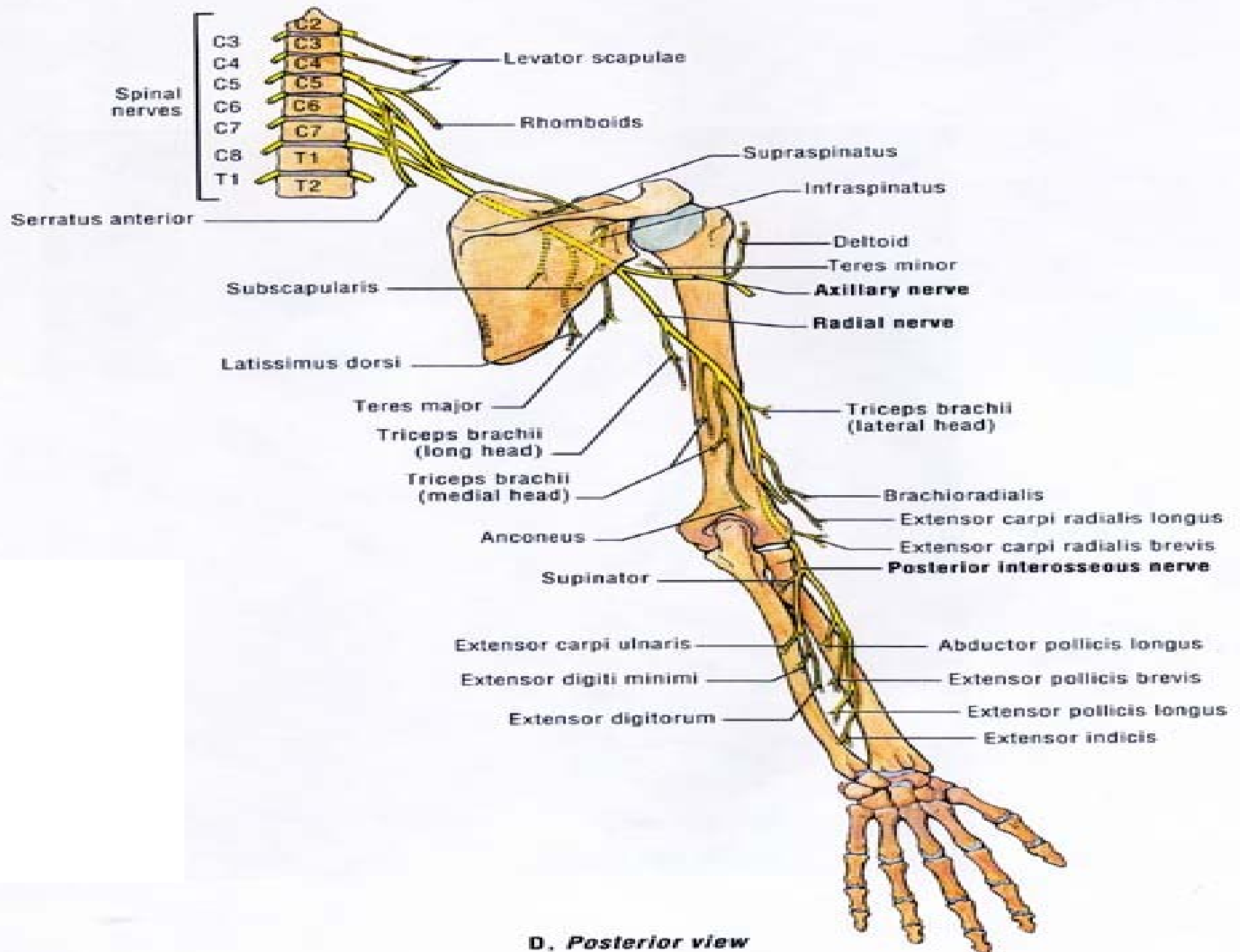


# **INNERVATION OF THE ARM**

- **Axillary n**
- **Ulnar n**
- **Radial n**
- **Musculocutaneous n**







**Axillary a.**

**Radial n.**

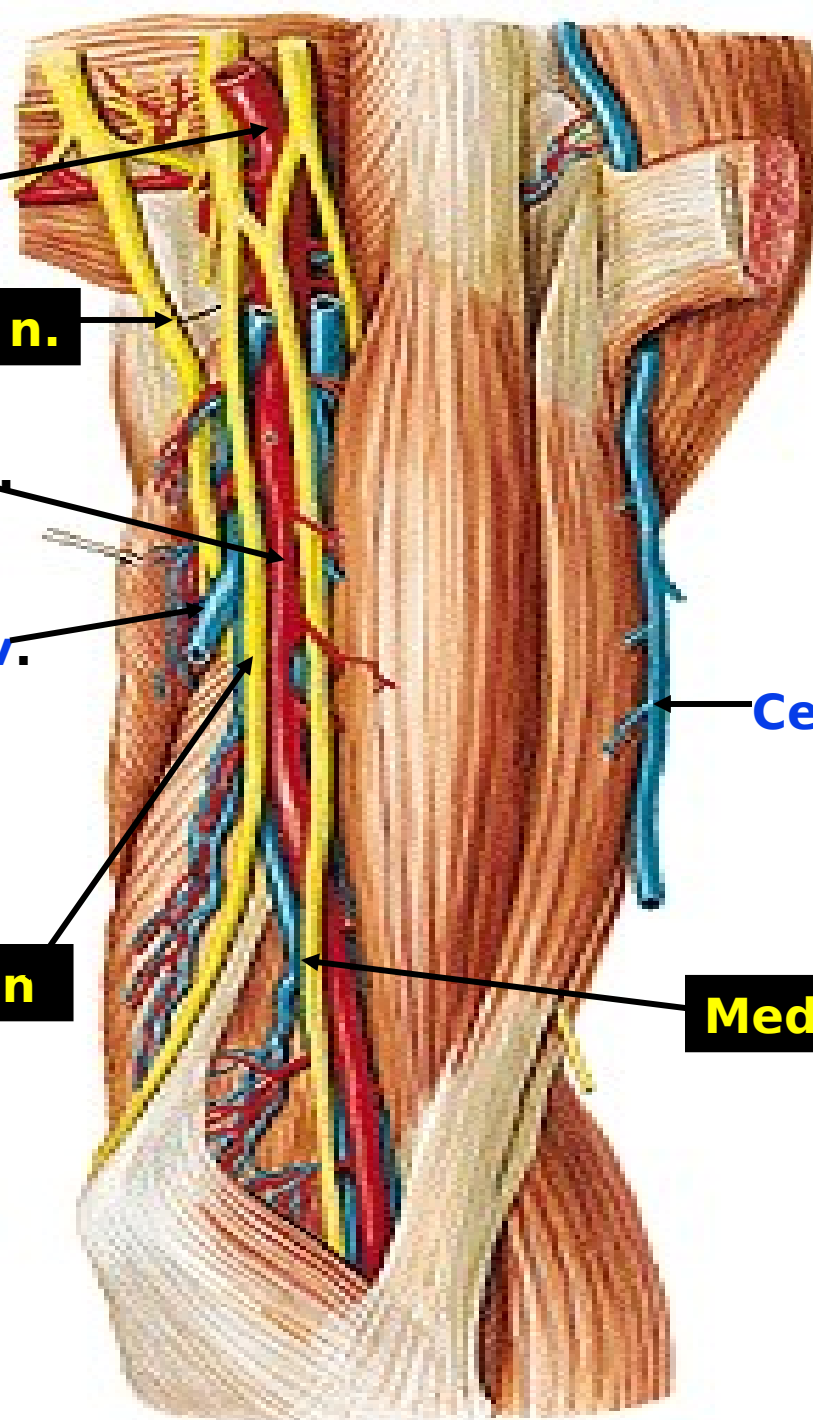
**Brachial a.**

**Basilic v.**

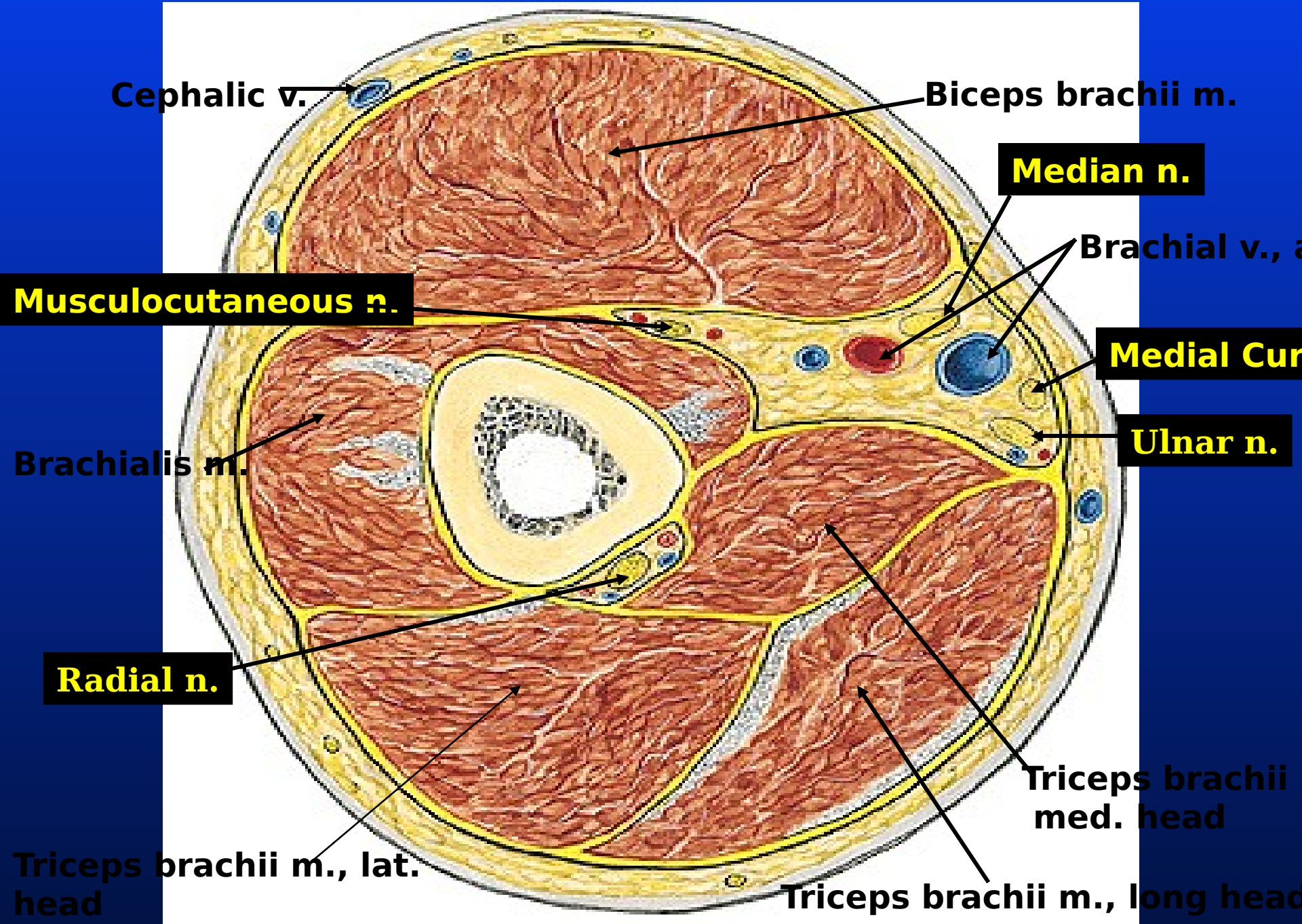
**Cephalic v.**

**Ulnar n.**

**Median n.**



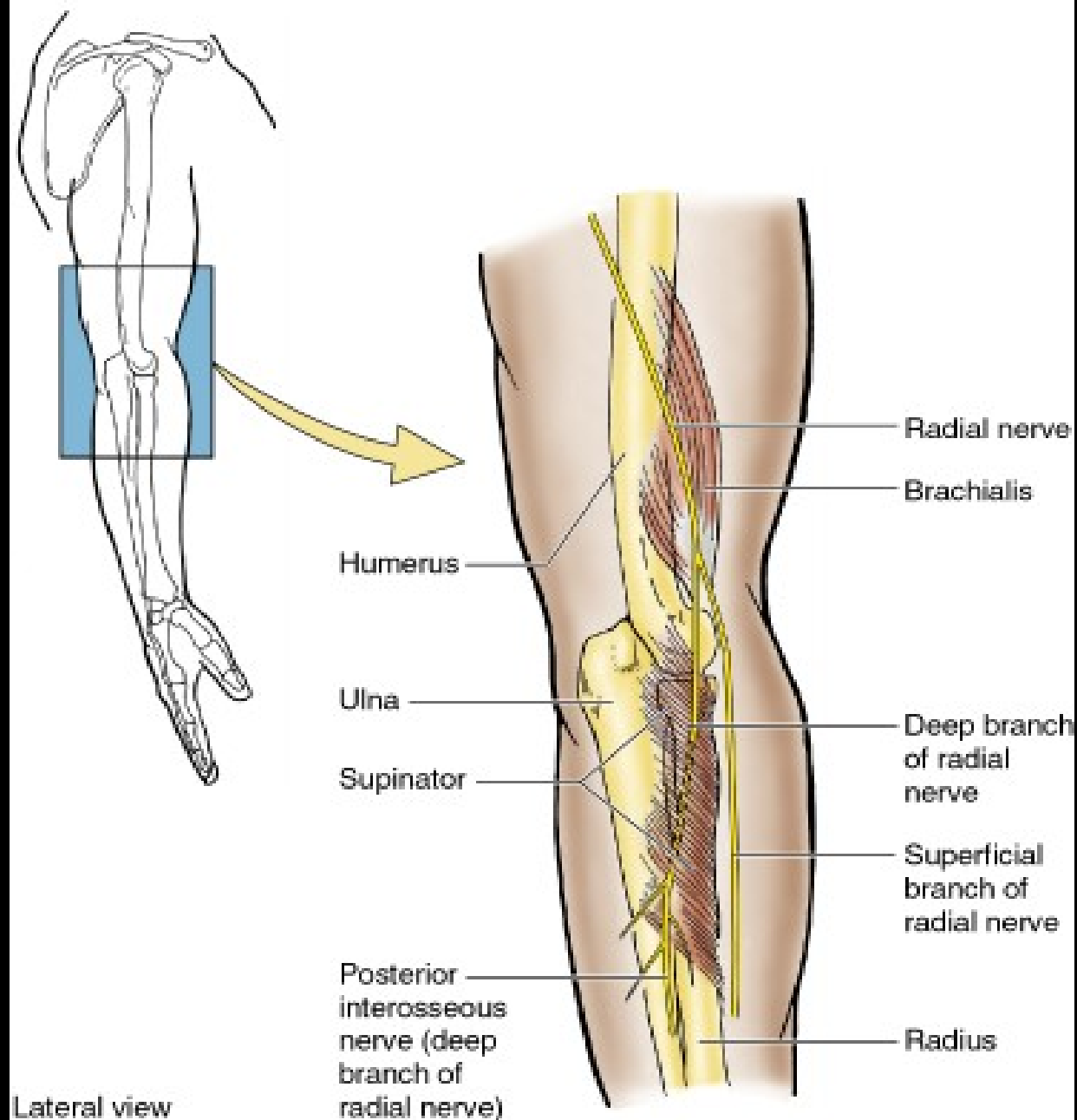
# Middle Rt. Arm

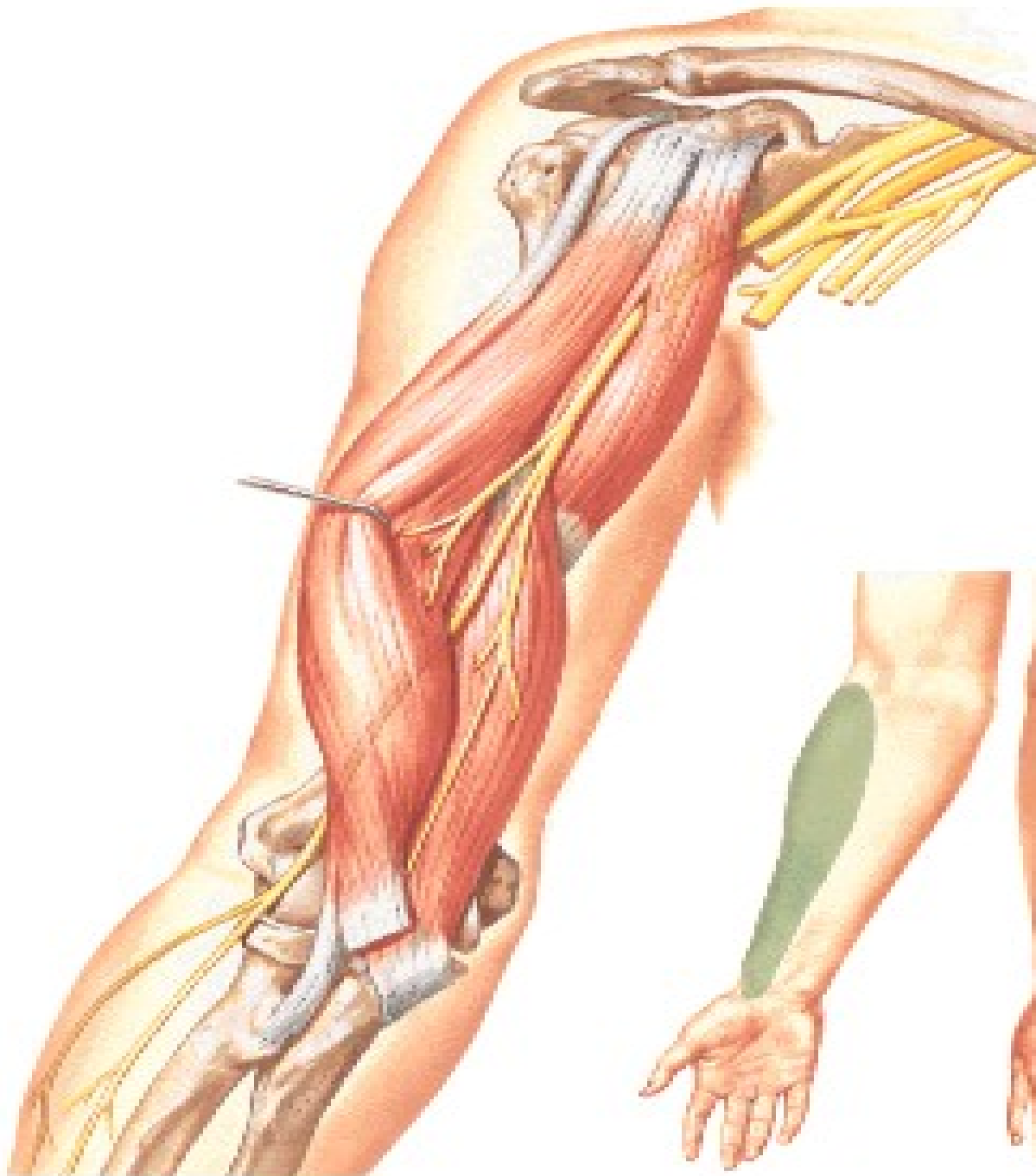


# NERVE SUPPLY TO ARM MUSCLES

- Radial nerve
  - Triceps brachii
  - Anconeus
  - Brachioradialis
- Musculocutaneous nerve
  - Biceps brachii
  - Brachialis

6.45. Relationship of the radial nerve to the brachialis and supinator muscles.

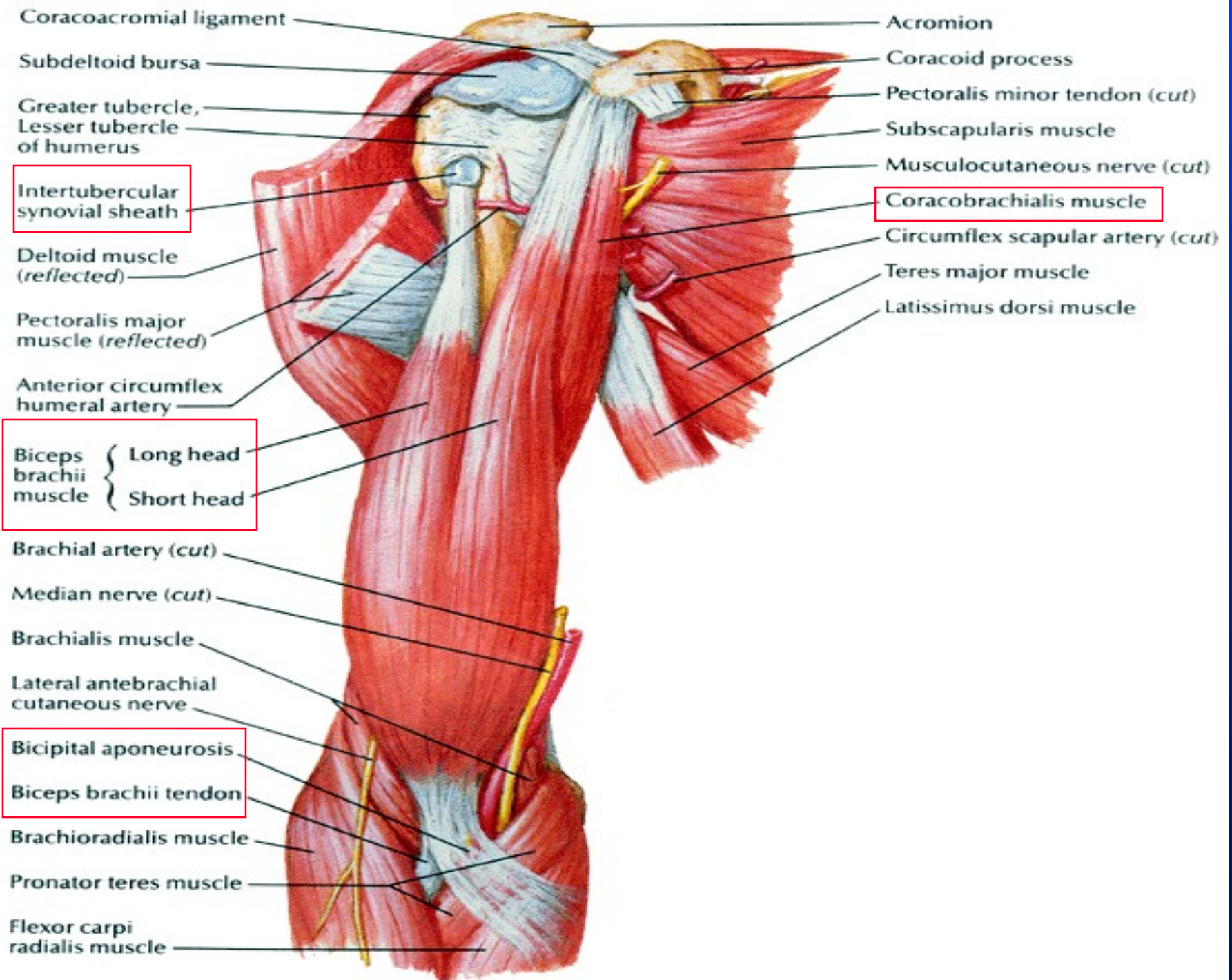




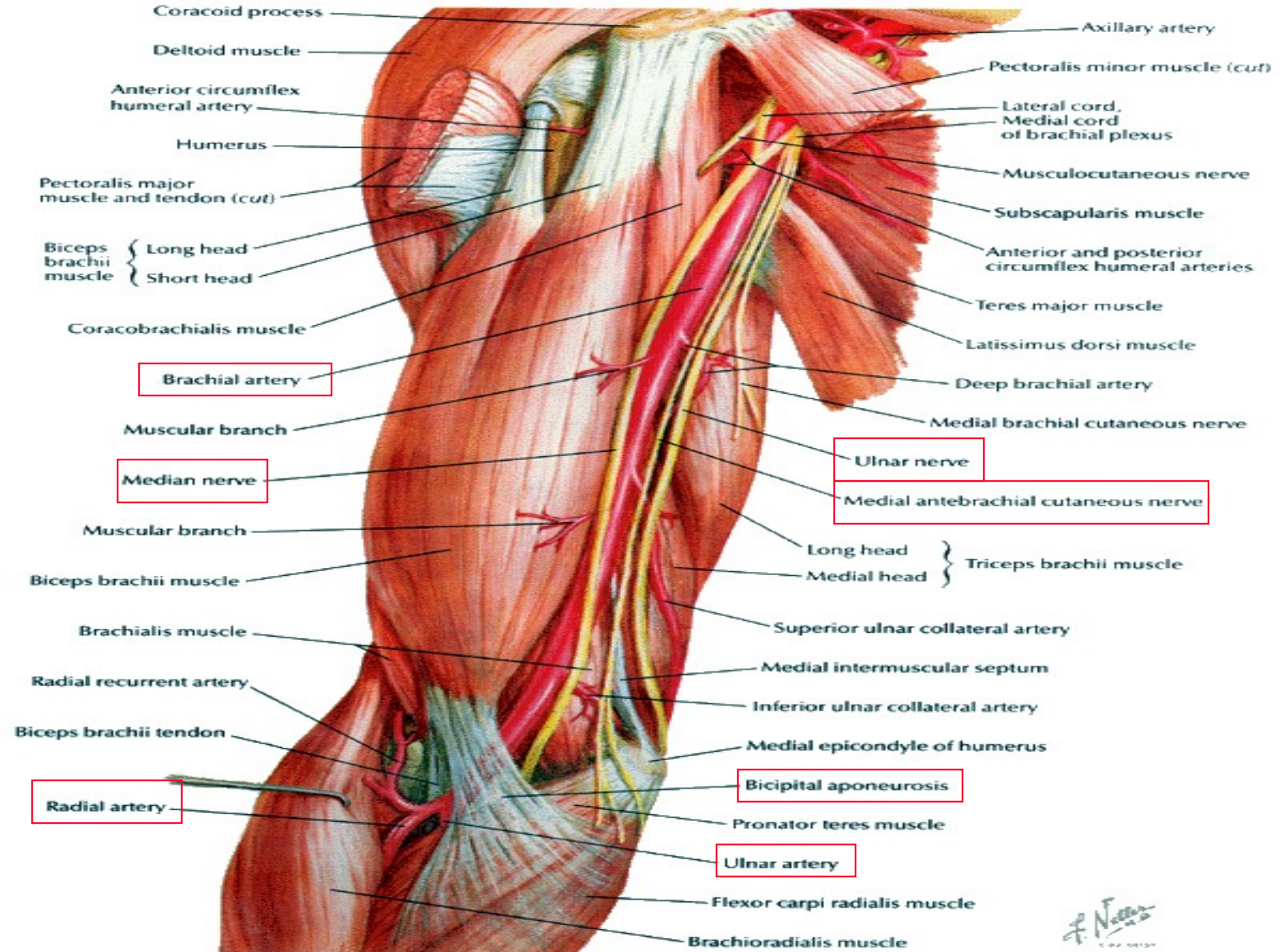
## Musculocutaneous nerve

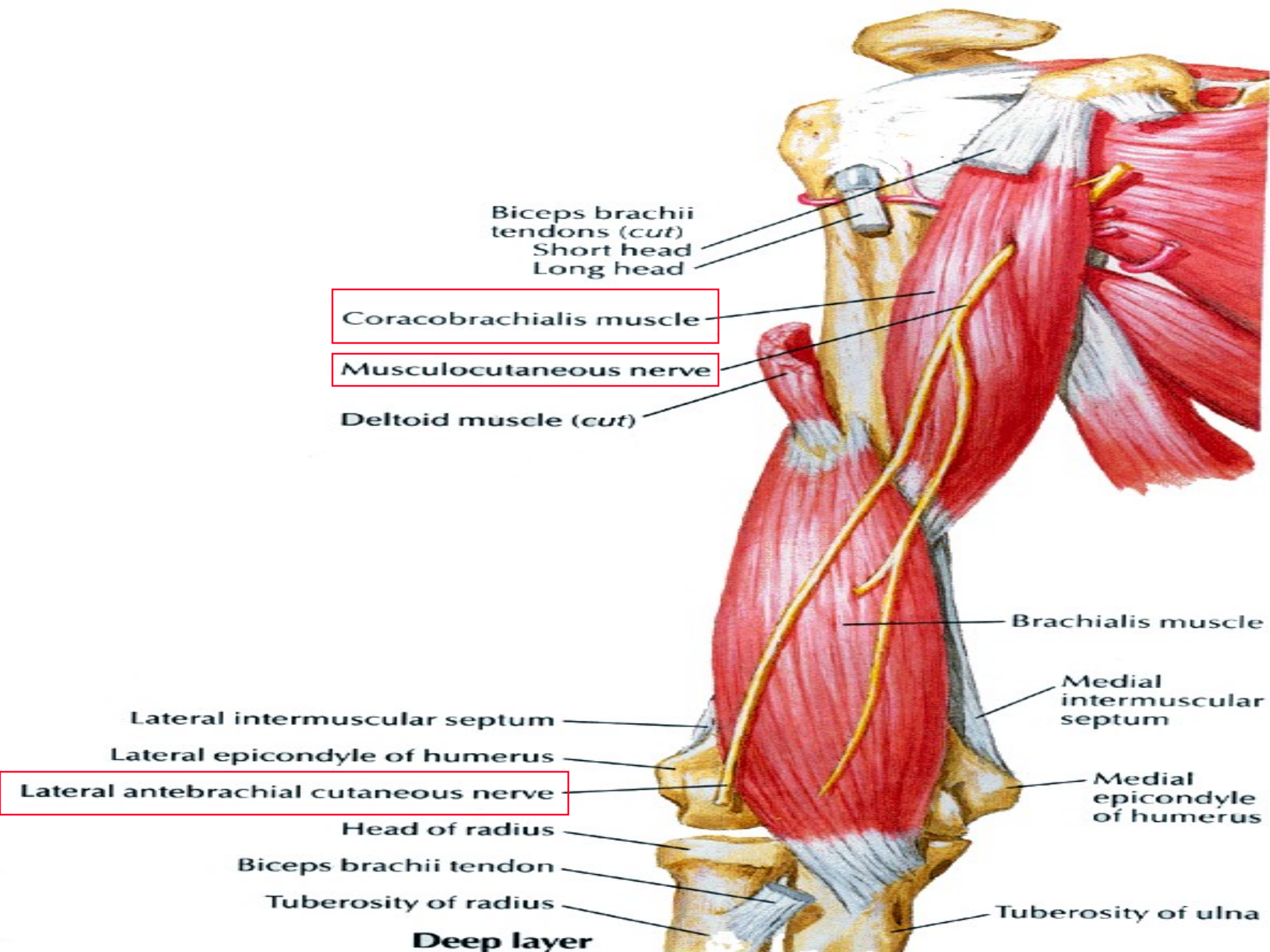
1. Flexor muscles
2. Skin as:  
Lateral antebrachial cutaneous nerve





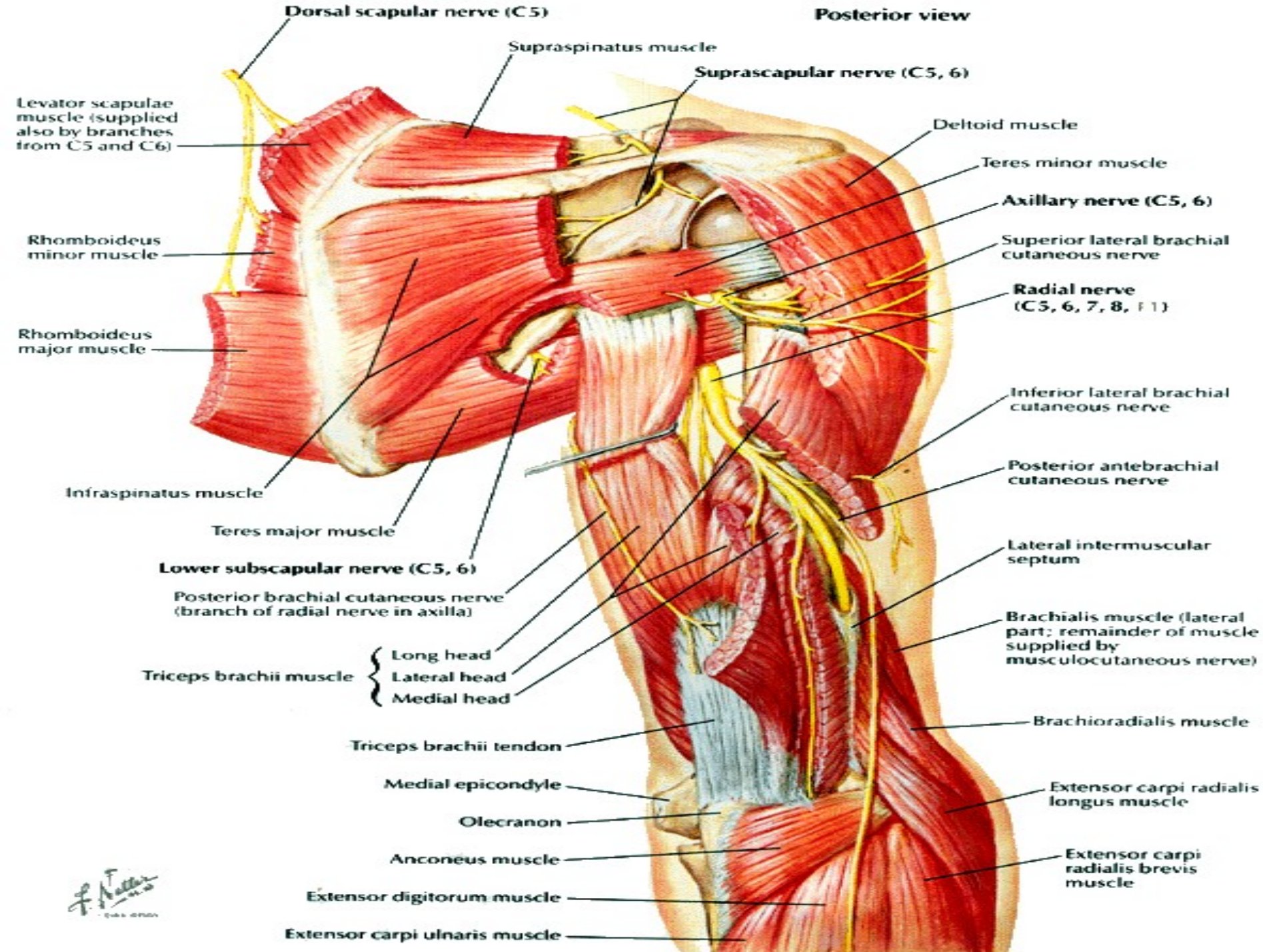


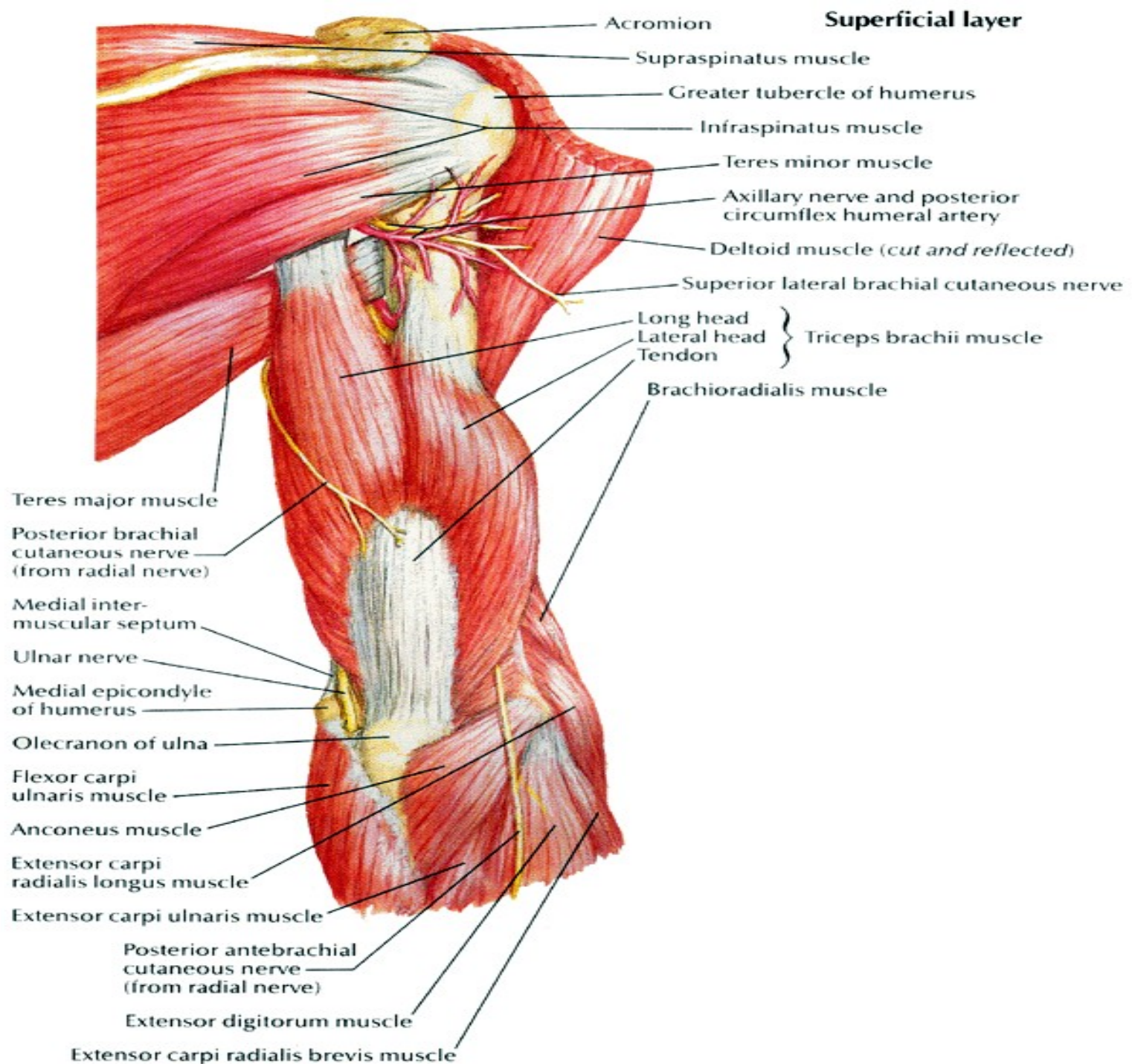




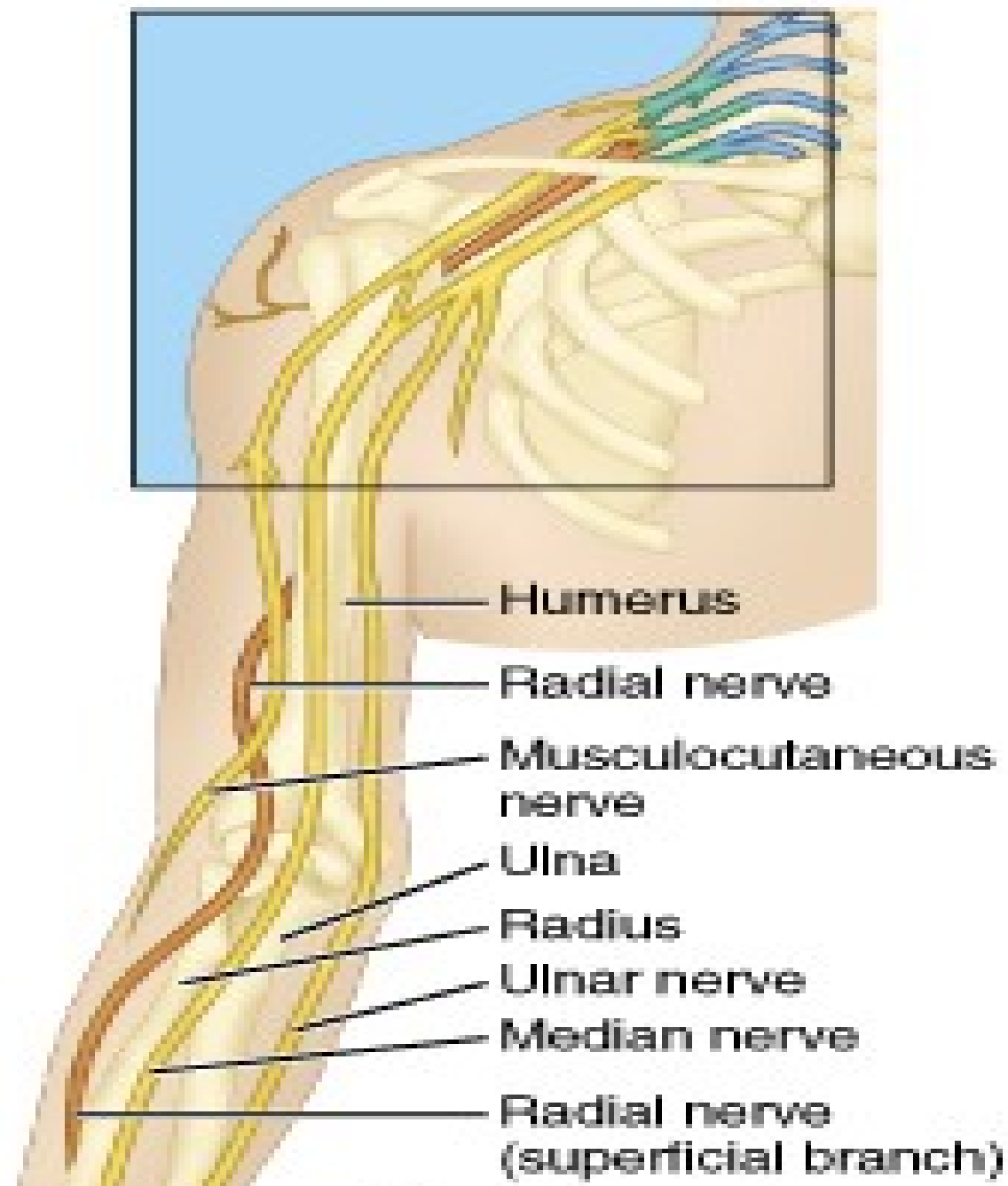


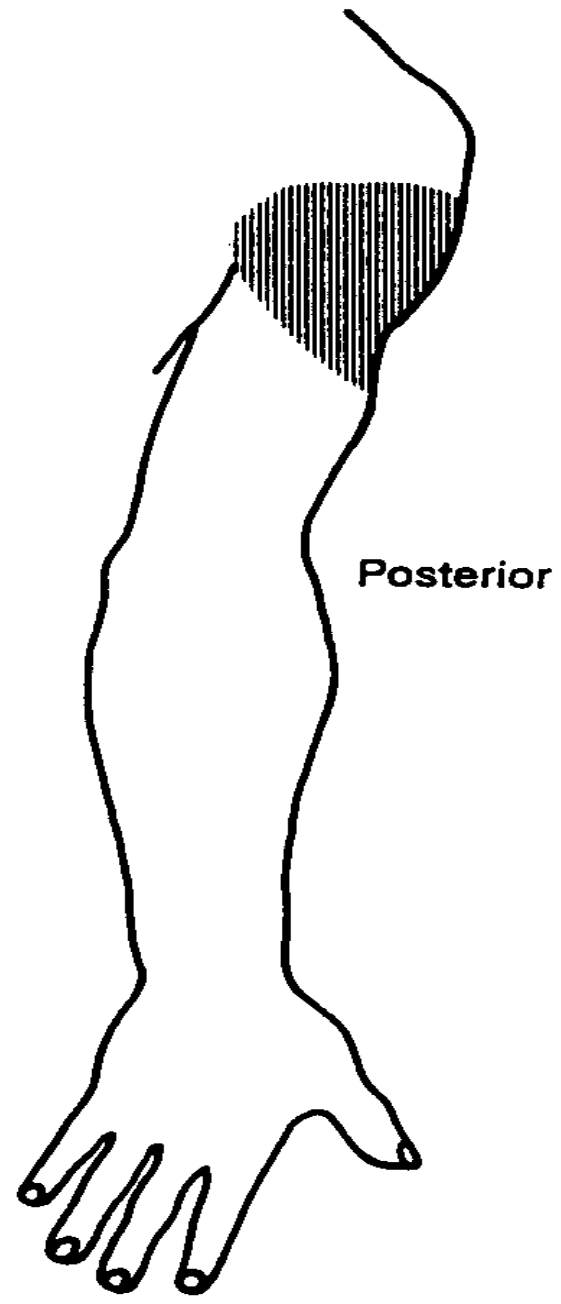
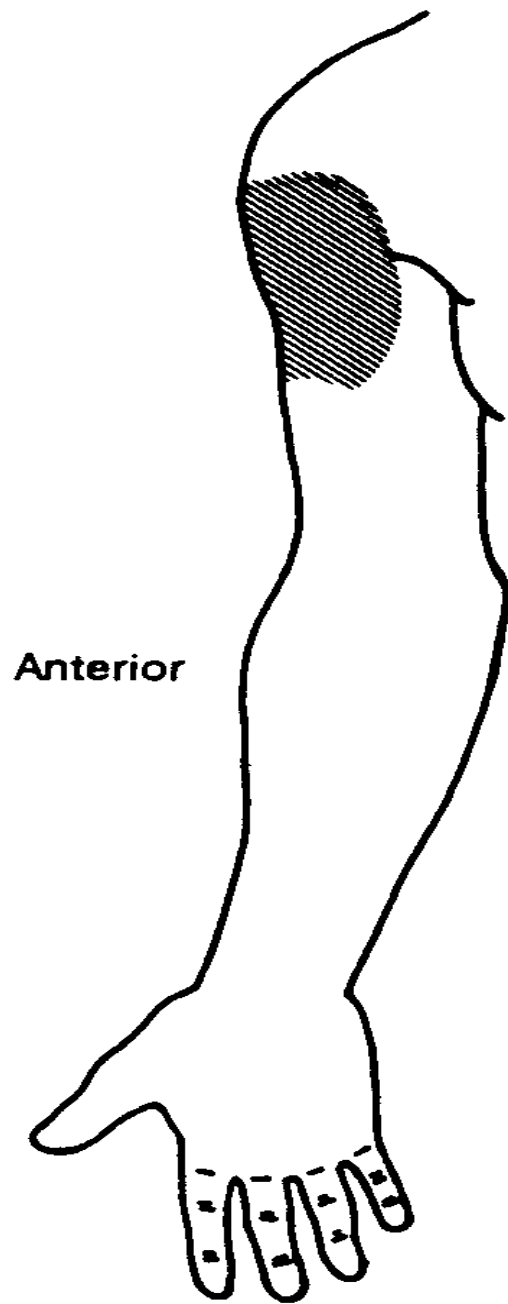
**Posterior view**



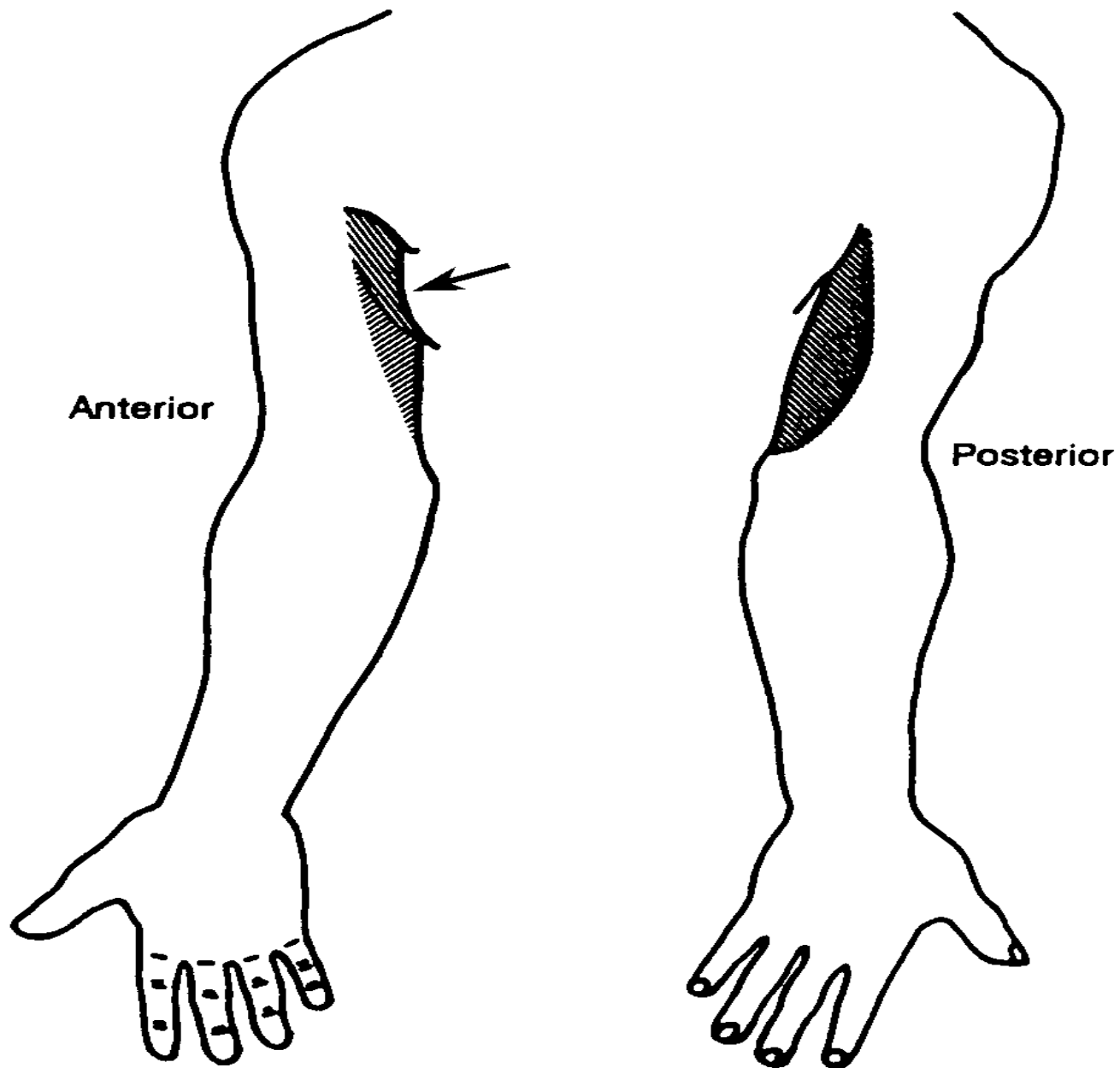






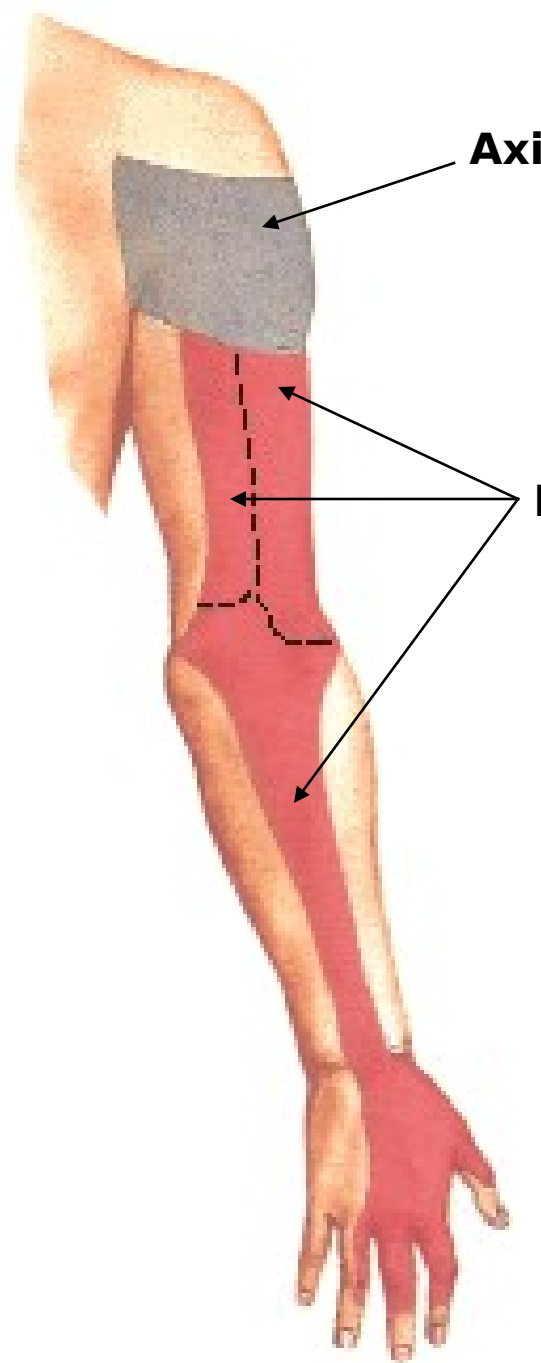


**Axillary**



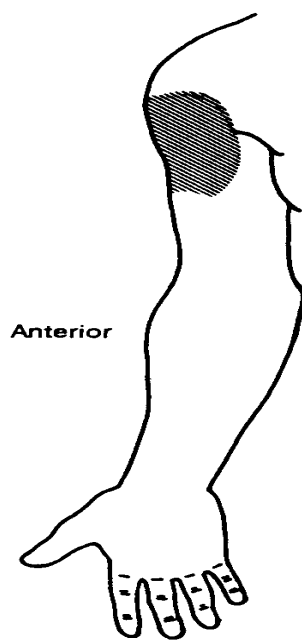
**Intercostobrachial (arrow) and  
medial brachial cutaneous**



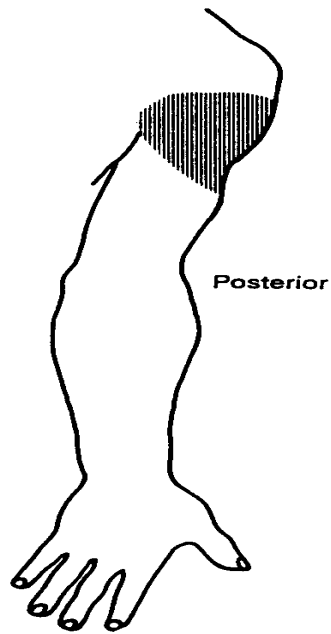


**Axillary cutaneous branch**

**Radial cutaneous branches**

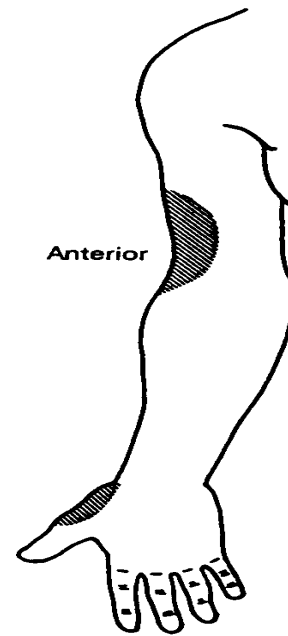


Anterior

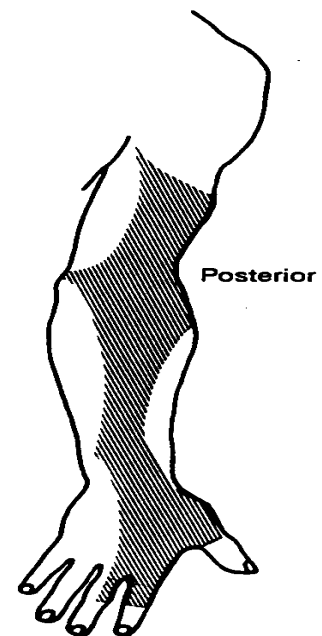


Posterior

**Axillary**

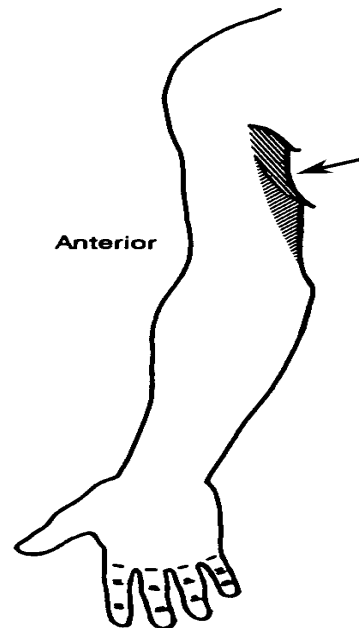


Anterior

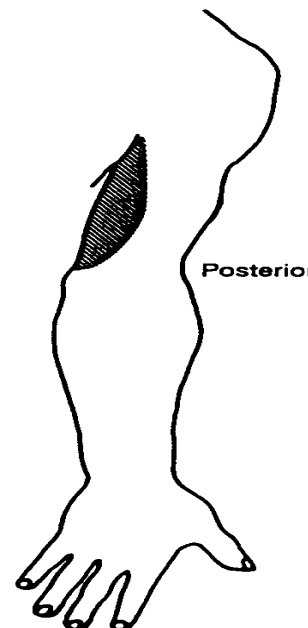


Posterior

**Radial**



Anterior



Posterior

**Intercostobrachial (arrow) and  
medial brachial cutaneous**

## Anterior view

Note: only muscles innervated by musculocutaneous nerve shown

Musculocutaneous nerve (C5, 6, 7)

Coracobrachialis muscle

Biceps brachii muscle  
(reflected)

Brachialis muscle

Articular branch

Lateral antebrachial cutaneous nerve

Anterior branch

Posterior branch

Medial  
Posterior  
Lateral } Cords of brachial plexus

Medial brachial cutaneous nerve

Medial antebrachial cutaneous nerve

Ulnar nerve

Median nerve

Radial nerve

Axillary nerve

*F. Netter M.D.*  
1989

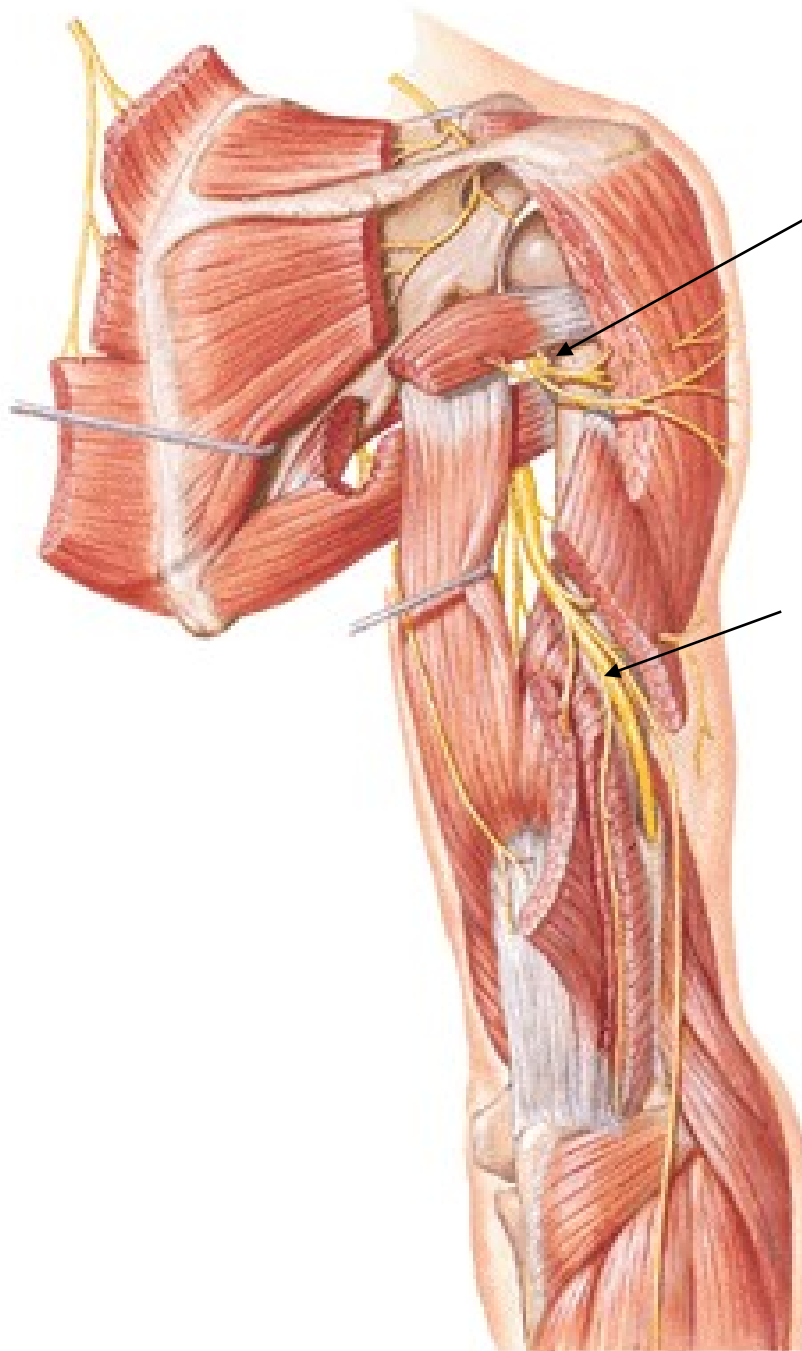


Cutaneous innervation

Anterior (palmar) view

Posterior (dorsal) view

## POSTERIOR VIEW



**Axillary nerve wraps around the surgical neck of the humerus**

**Radial nerve wraps around the shaft of the humerus**

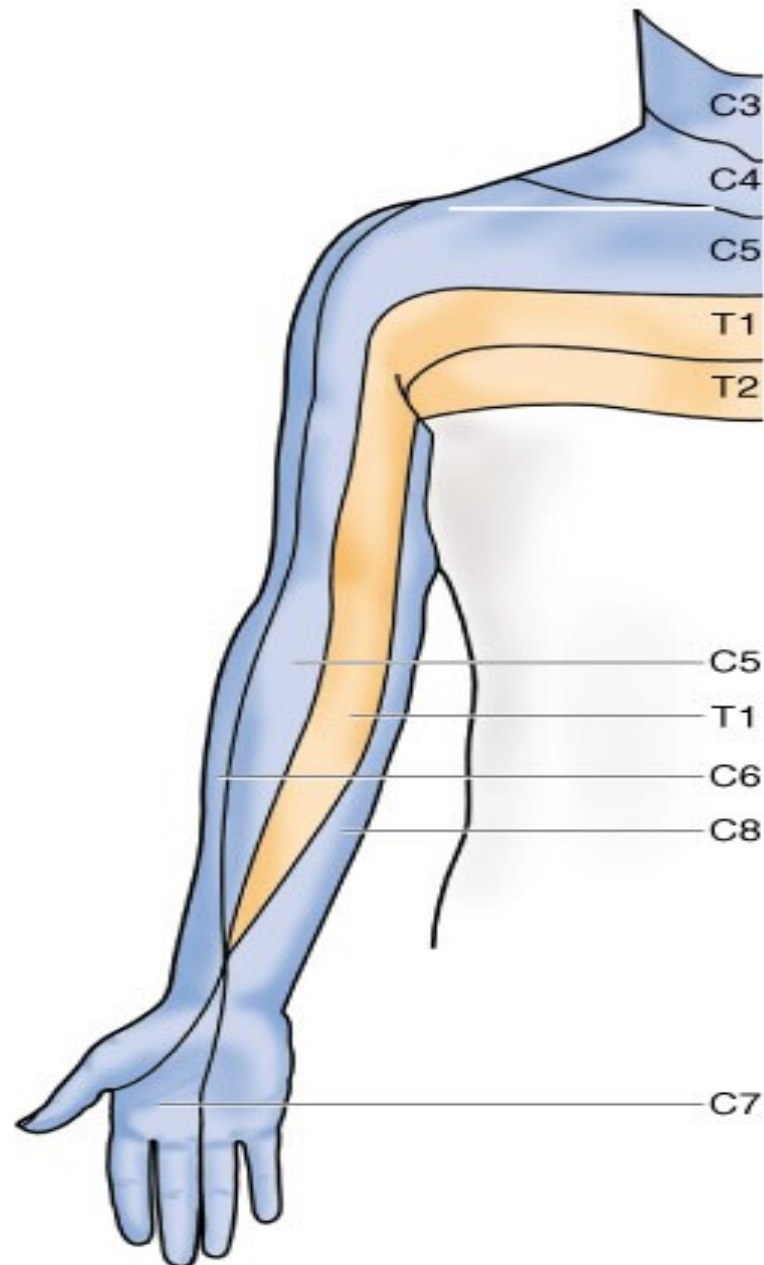
# **Innervation of Skin: Dermatomes**

- The area of skin innervated by the cutaneous branches of a single spinal nerve
- All but spinal nerve C<sub>1</sub> participate in dermatomes
- Skin of the upper limbs - ventral rami of C<sub>5</sub> - T<sub>1 or 2</sub>



**Figure 6.11. Segmental (dermatomal) and peripheral (cutaneous nerve) innervation of the upper limb.** Anterior (A) and posterior (B) views showing the distribution of the peripheral (named cutaneous) nerves, which usually are branches of nerve plexuses and therefore contain fibers from more than one spinal nerve or spinal cord segment. The segmental (dermatomal) pattern of innervation of the limbs is also shown. A *dermatome* is the area of skin receiving sensory innervation from the dorsal root of a single spinal nerve or spinal cord segment through the dorsal and ventral rami (root) of that spinal nerve. Neighboring dermatomes usually overlap extensively so that loss of innervation to the skin consequent to damage to a single dorsal root may involve only a small part of the indicated dermatome.

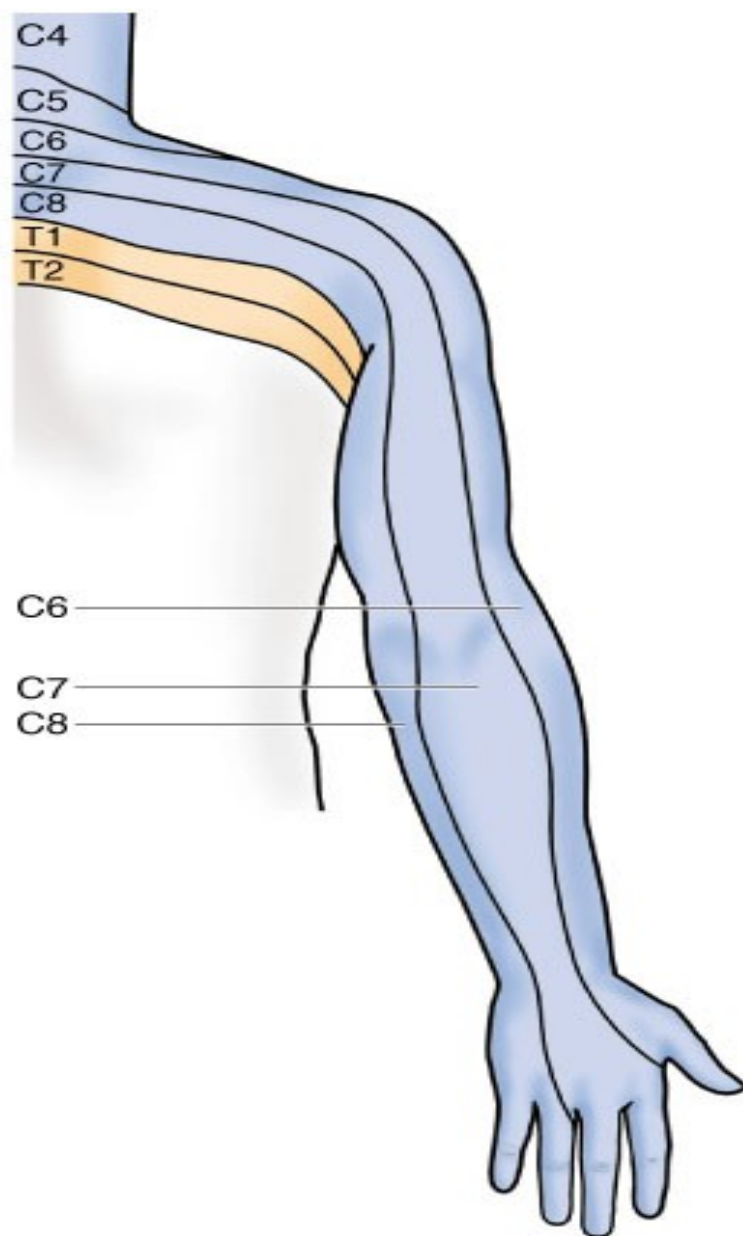
6.11A, left. Segmental innervation of skin (dermatomes), anterior.



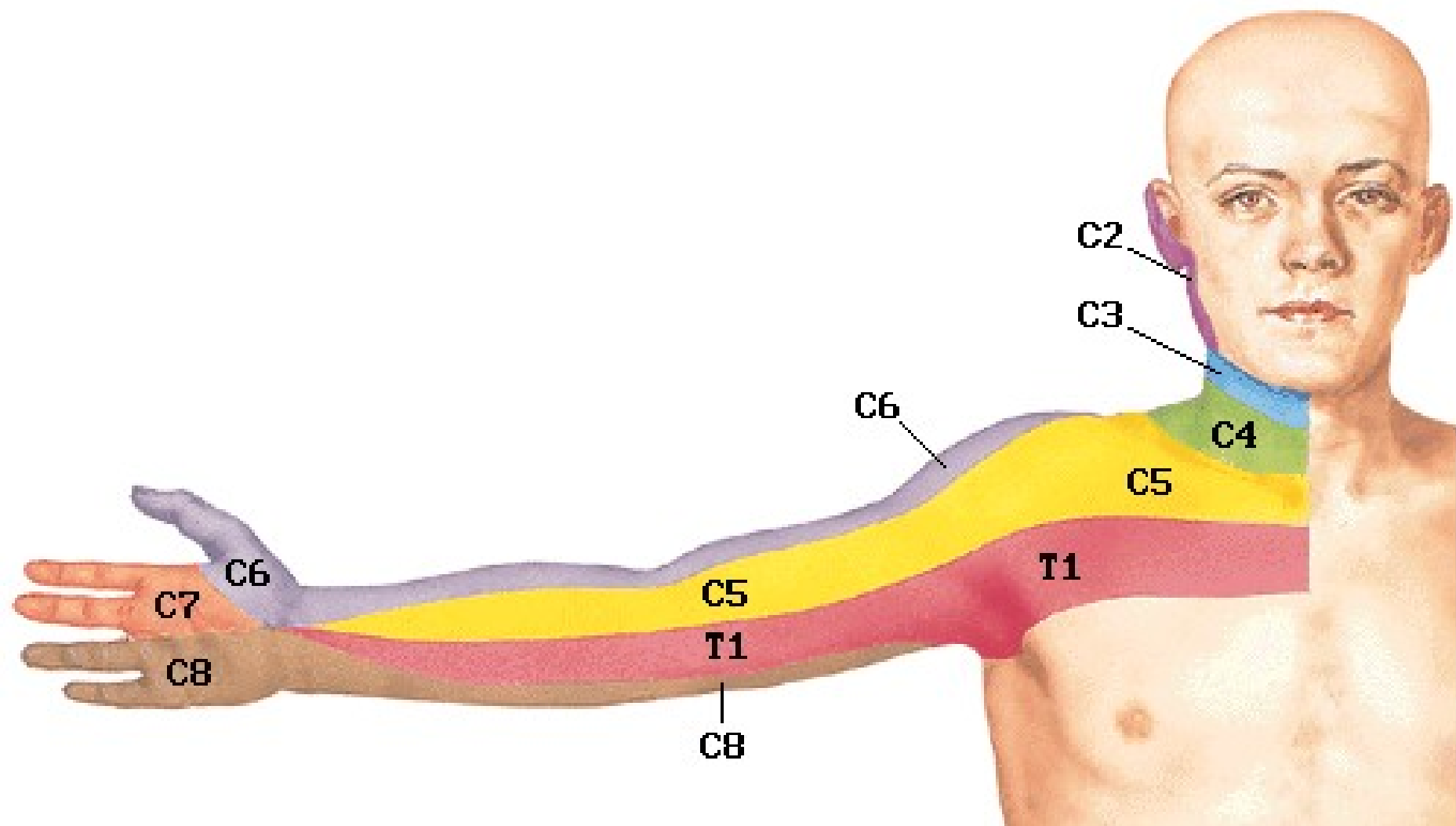
Segmental innervation  
of skin (dermatomes)

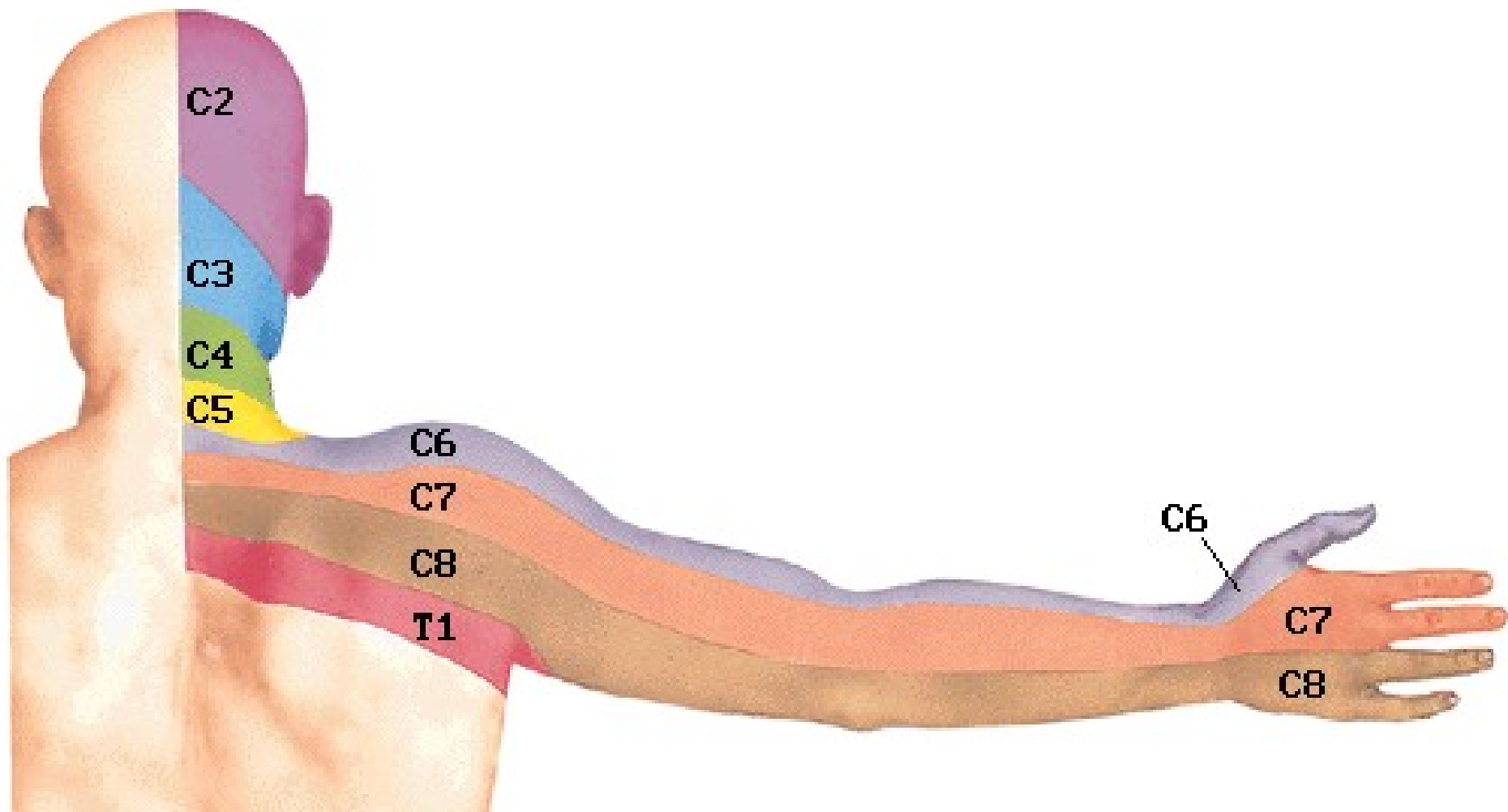


6.11B, left. Segmental innervation of skin (dermatomes), posterior.



Segmental innervation of  
skin (dermatomes)





Supraclavicular nerves  
(from cervical plexus - C3,4)

Superior lateral cutaneous nerve  
of arm (from axillary nerve - C5,6)

Inferior lateral cutaneous nerve  
of arm (from radial nerve - C5,6)

Intercostobrachial nerve (T2) and medial  
cutaneous nerve of arm (C8,T1,2)

Lateral cutaneous nerve of forearm (terminal  
part of musculocutaneous nerve - C5,6,[7])

Medial cutaneous nerve of forearm (C8,T1)

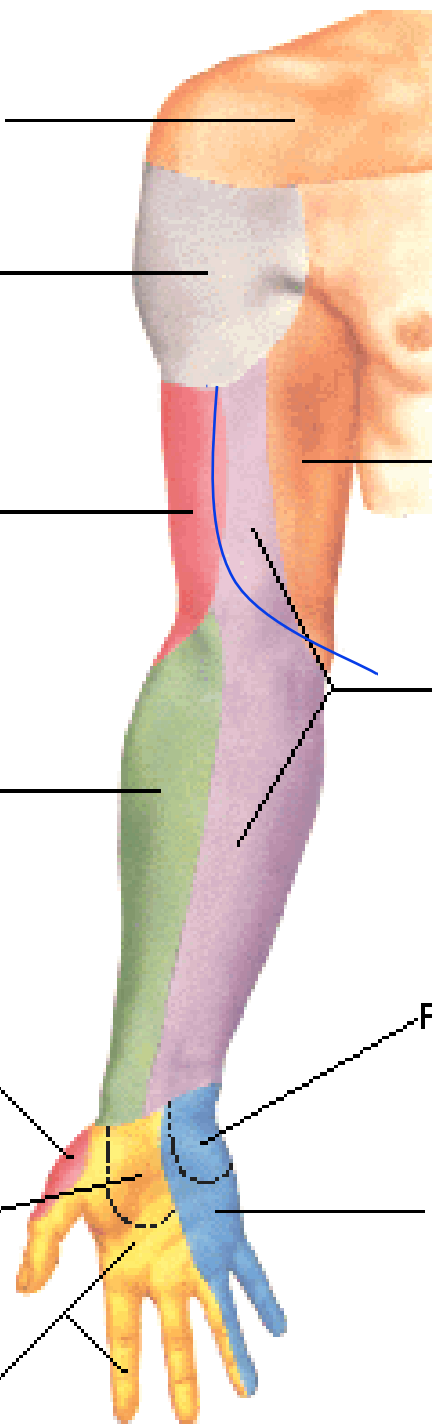
Superficial branch of radial nerve (C6,7,8)

Palmar branch of ulnar nerve (C8,T1)

Palmar branch of median nerve (C6,7,8)

Palmar digital branches of ulnar nerve (C8,T1)

Palmar digital branches of median nerve (C6,7,8)



Superior lateral cutaneous nerve of arm (from axillary nerve - C5,6)

Supraclavicular nerves (from cervical plexus - C3,4)

Intercostobrachial nerve (T2) and medial cutaneous nerve of arm (C8,T1,2)

Posterior cutaneous nerve of arm (from radial nerve - C5,6,7,8)

Posterior cutaneous nerve of forearm (from radial nerve - C[5],6,7,8)

Inferior lateral cutaneous nerve of arm (from radial nerve)

Medial cutaneous nerve of forearm (C8,T1)

Lateral cutaneous nerve of forearm (terminal part of musculocutaneous nerve - C5,6,[7])

Dorsal branch and dorsal digital branches of ulnar nerve (C8,T1)

Proper palmar digital branches of ulnar nerve (C8,T1)

Superficial branch and dorsal digital branches of radial nerve (C6,7,8)

Proper palmar digital branches of median nerve

Division variable between ulnar and radial  
on dorsum of hand and often aligns with  
of 3rd digit instead of 4th digit as shown

# LYMPHATICS

**Figure 6.13. Lymphatic drainage of the upper limb.** Superficial lymphatic vessels begin in the skin of the hand from digital lymphatic vessels and the lymphatic plexus of the hand. Most drainage from the palm passes to the dorsum of the hand (*arrows*). The vessels ascend through the forearm and arm, converging toward the cephalic vein and especially the basilic vein to reach the *axillary lymph nodes*. Some lymph first passes through the *cubital lymph nodes* in the elbow region or *deltopectoral nodes* in the shoulder region. Deep lymphatic vessels (less numerous than superficial vessels) follow the main neurovascular bundles and drain lymph from the joint capsules, periosteum, tendons, nerves, and muscles. A few lymph nodes are present along their course, which end primarily in the humeral (lateral) and then the central axillary lymph nodes.



## Surface Anatomy: Axillary Lymph Nodes

Lateral  
Axillary  
Central  
Axillary  
Subscapular  
Pectoral

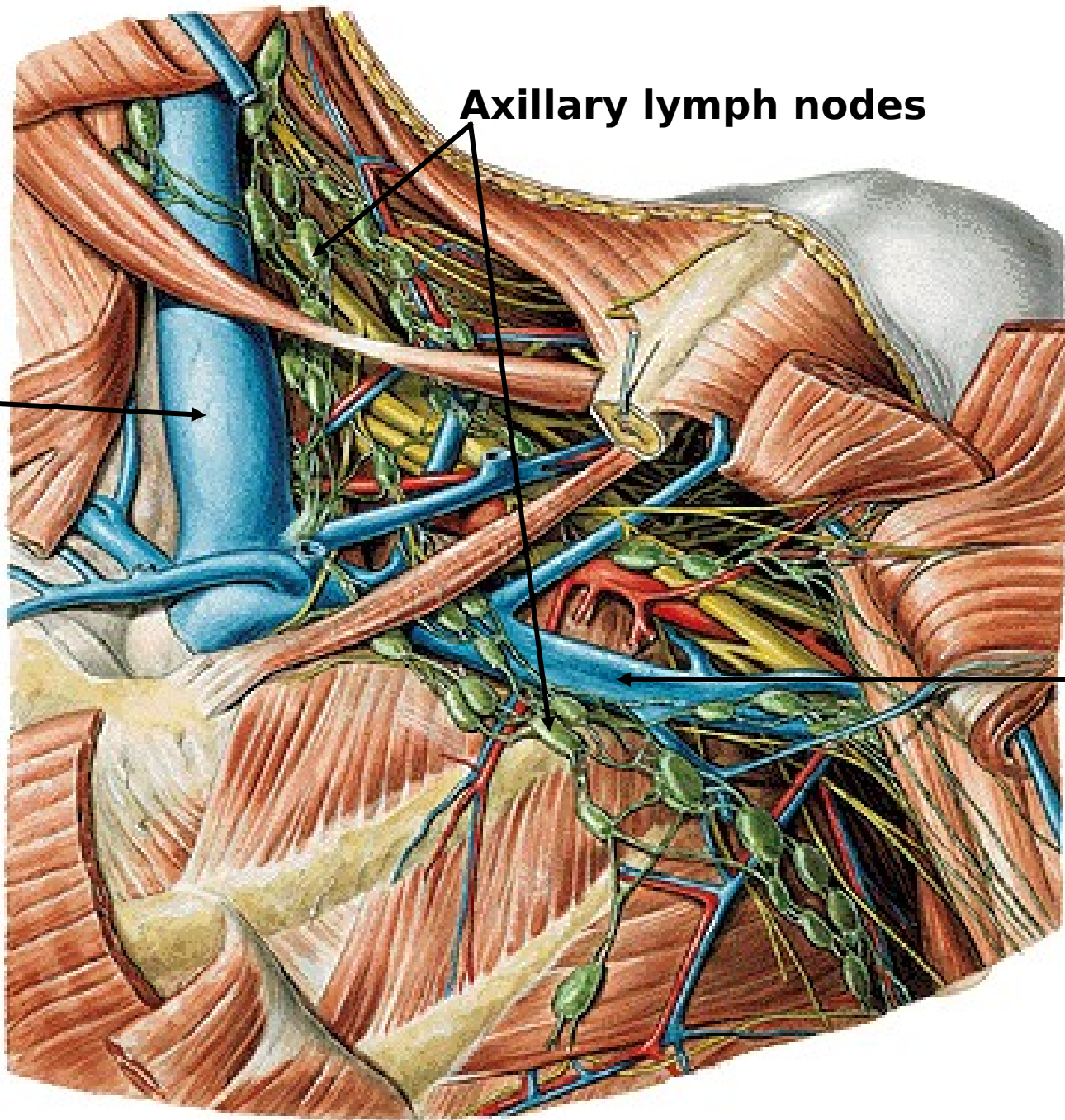


Roll mouse over image to display axillary lymph node regions.  
Note the central axillary nodes lie deep within the axilla.

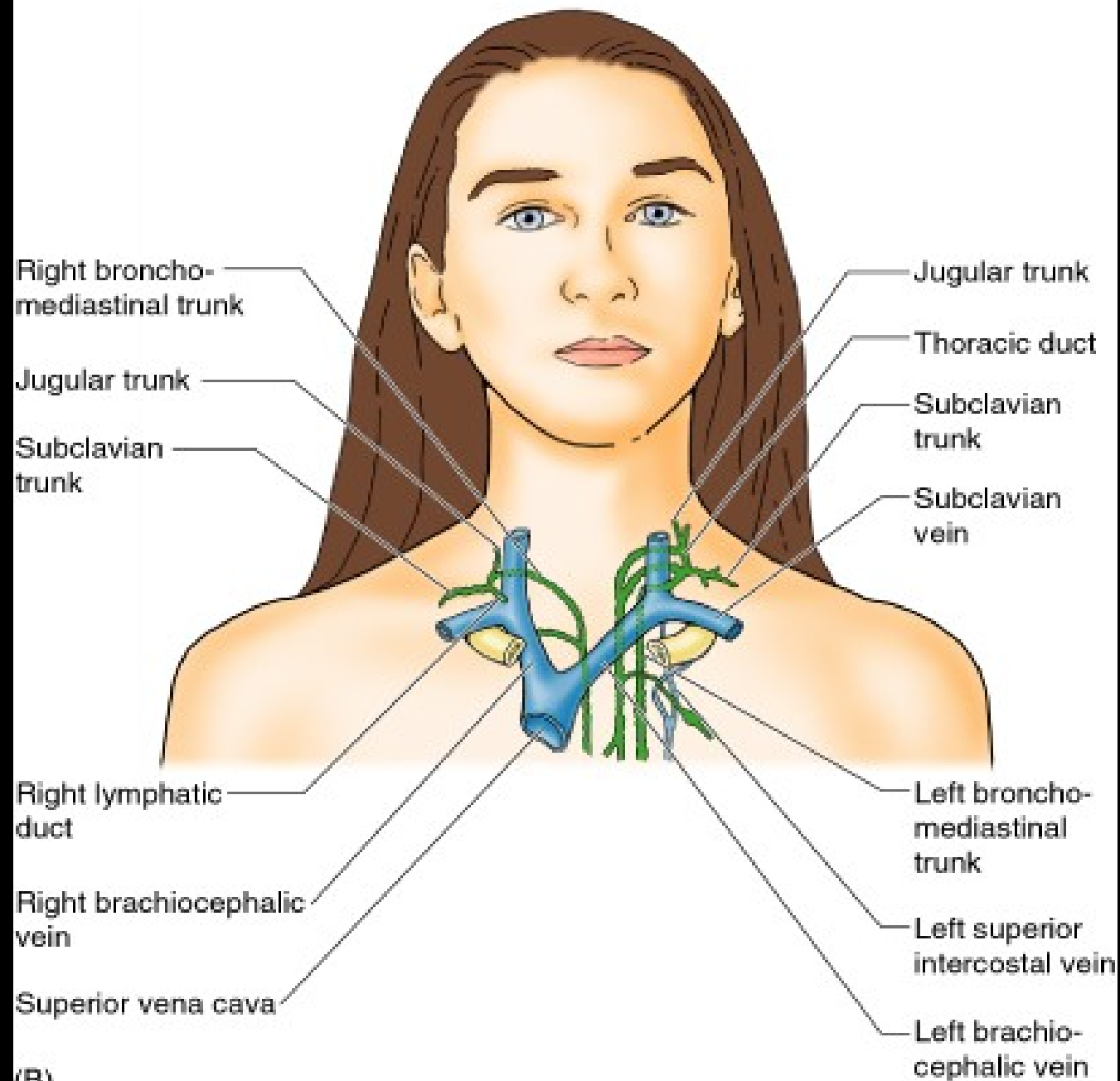
**Jugular v.**

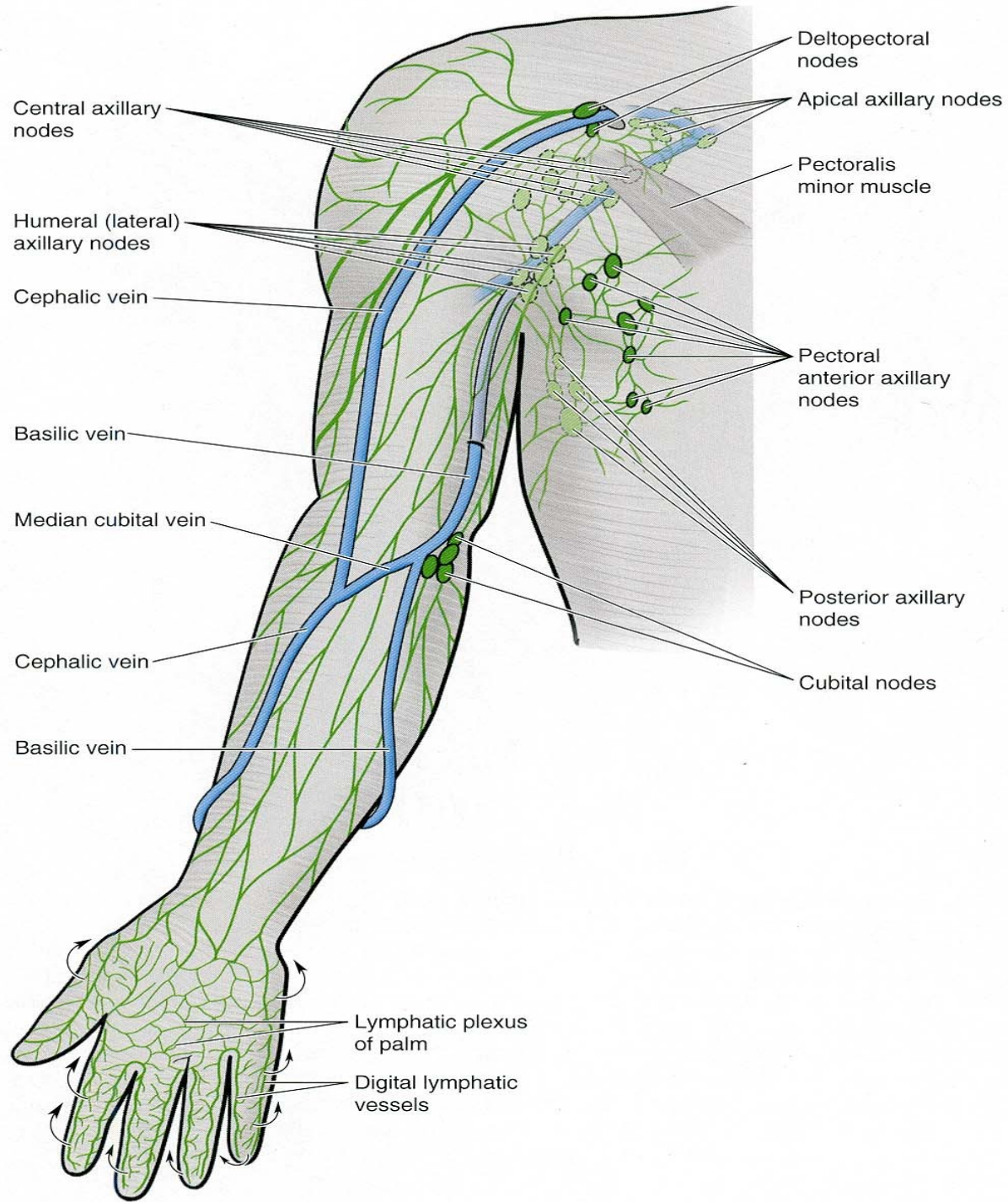
**Axillary lymph nodes**

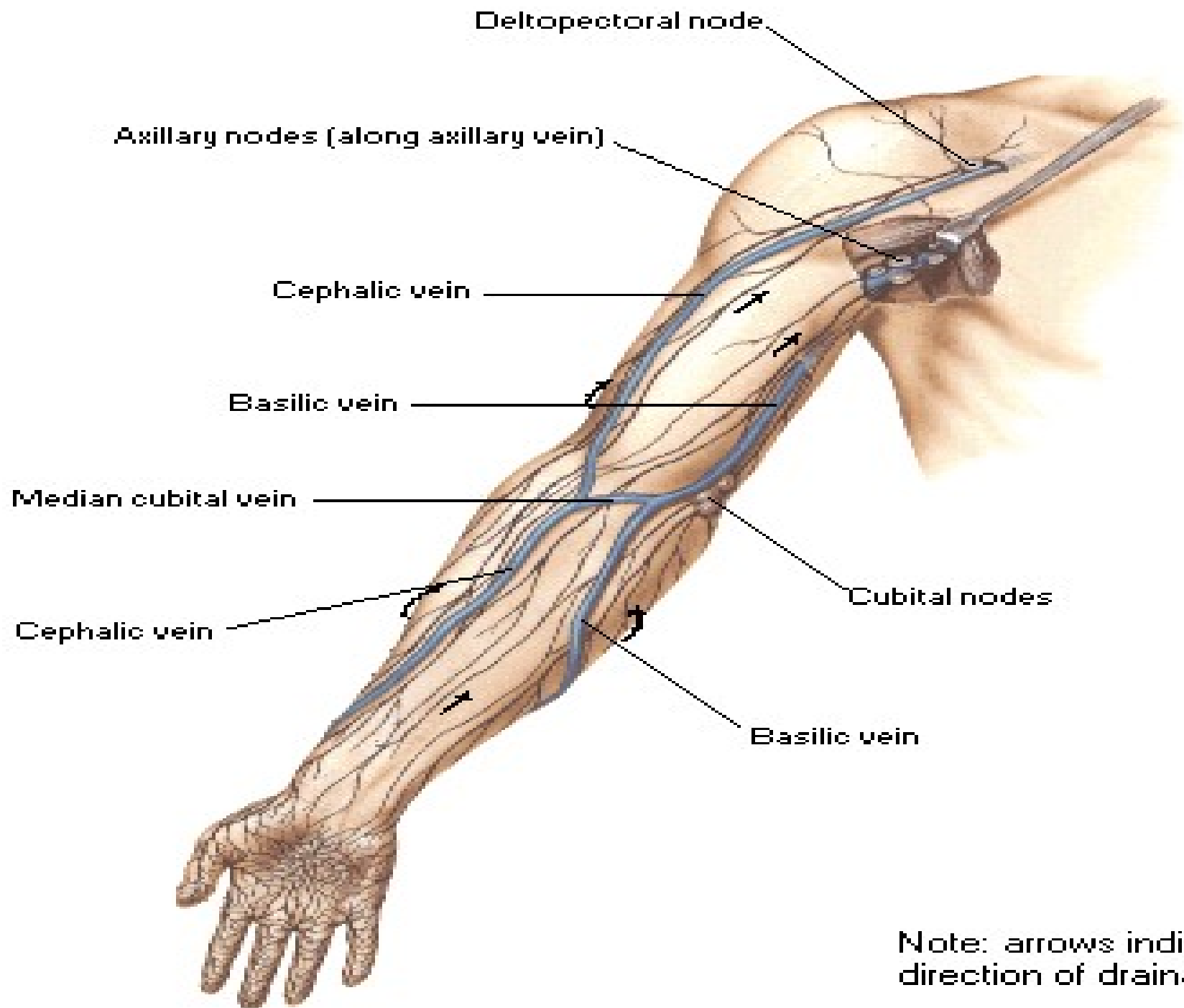
**Axillary v.**



6.27B. Lymphatic drainage of the right upper limb and breast.







Note: arrows indicate direction of drainage.

**Regional lymph nodes:**

Cervical nodes

Axillary nodes

Inguinal nodes

Entrance of right lymphatic duct into right subclavian vein

Internal jugular vein

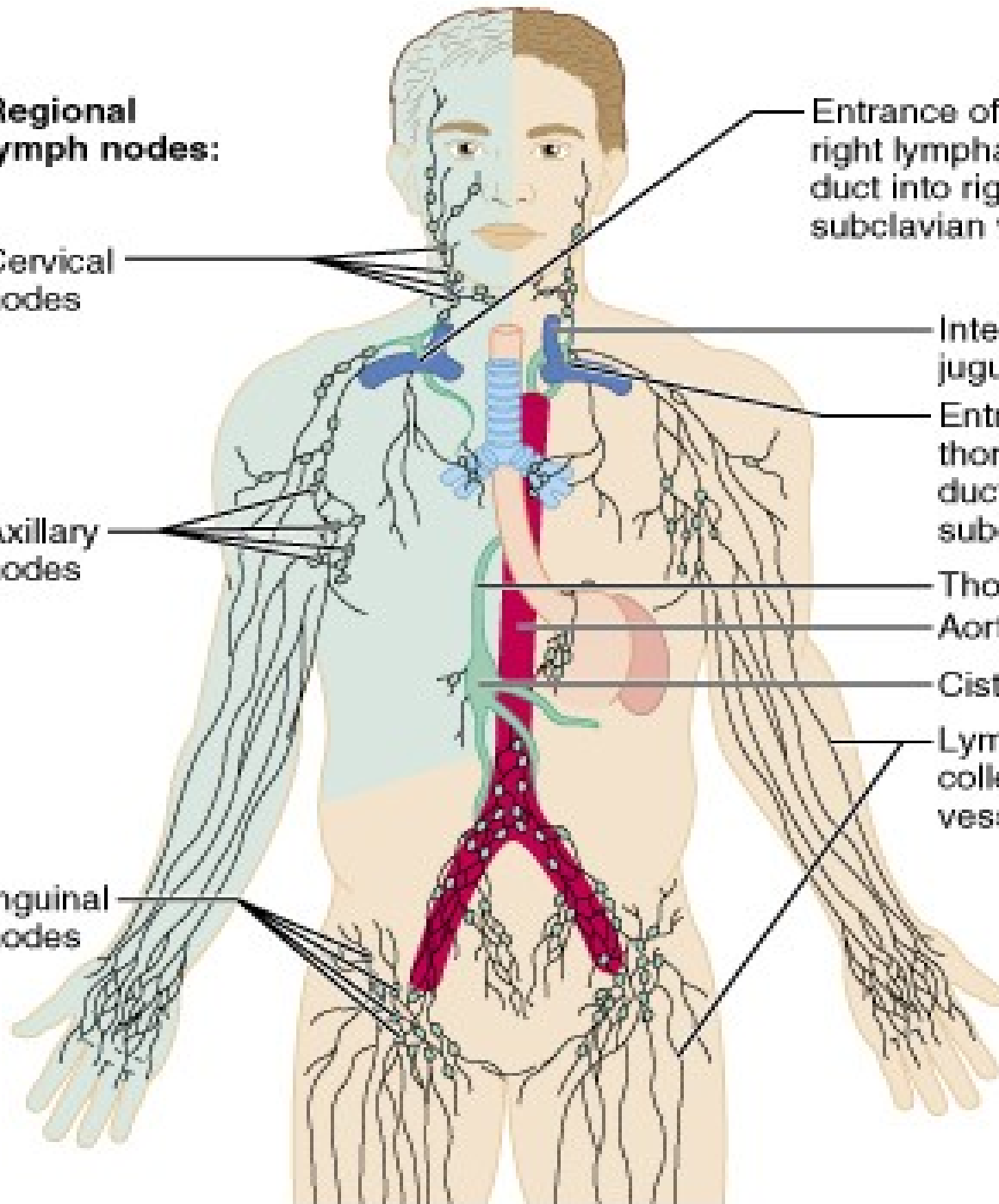
Entrance of thoracic duct into left subclavian vein

Thoracic duct

Aorta

Cisterna chyli

Lymphatic collecting vessels



**QUESTIONS**  
**?**

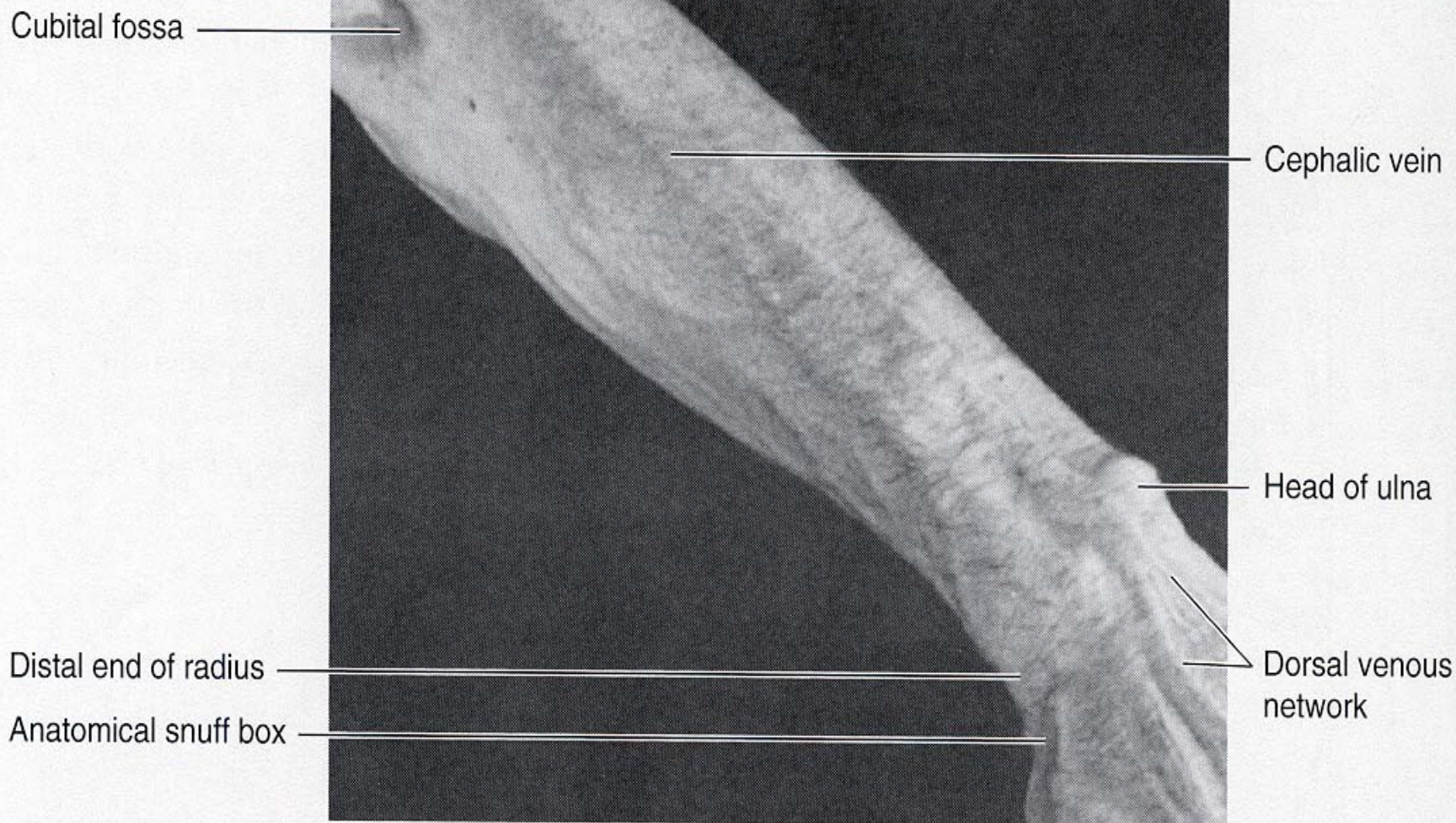


# THE FOREARM

Anatomy & Physiology I

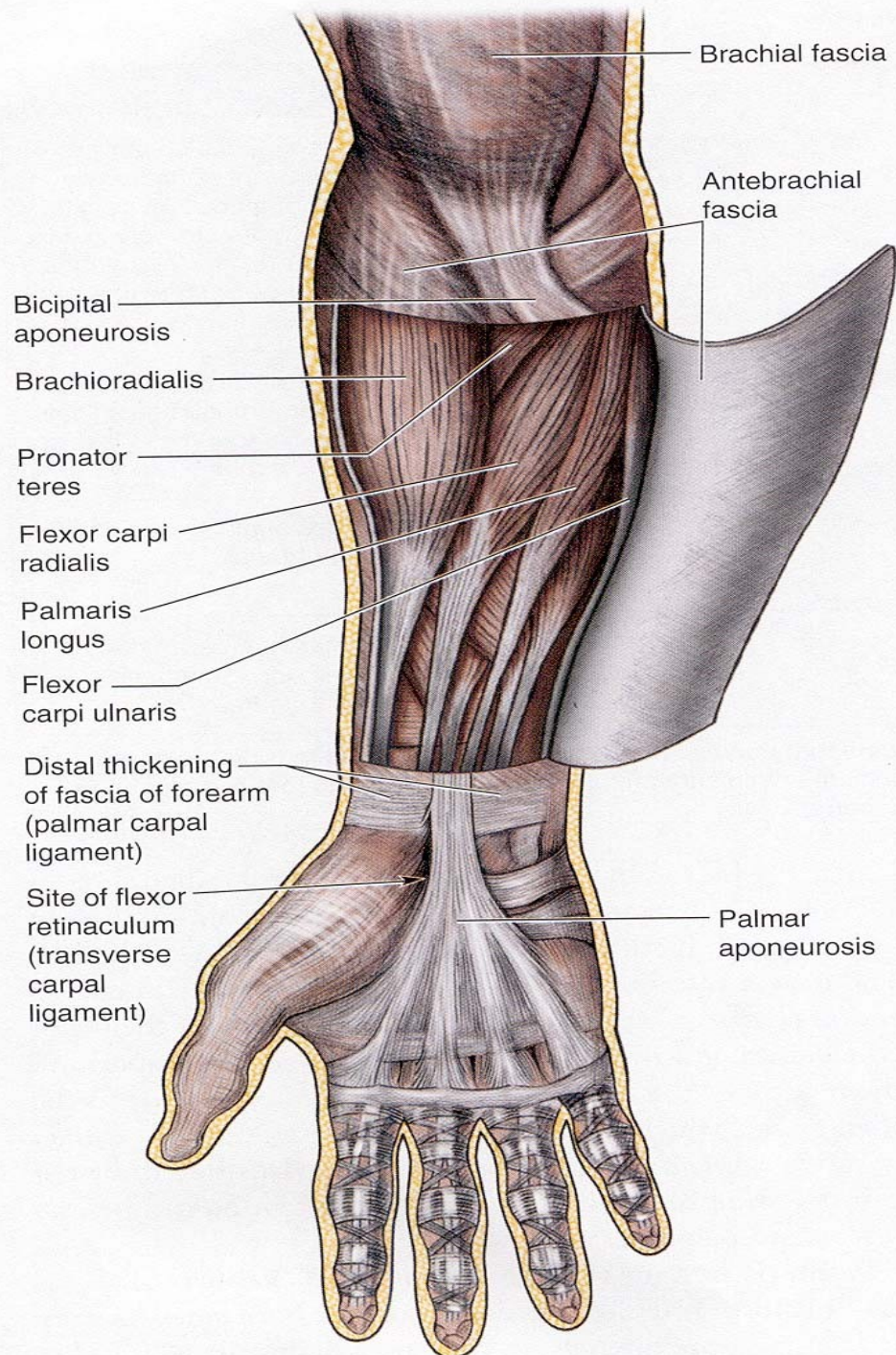




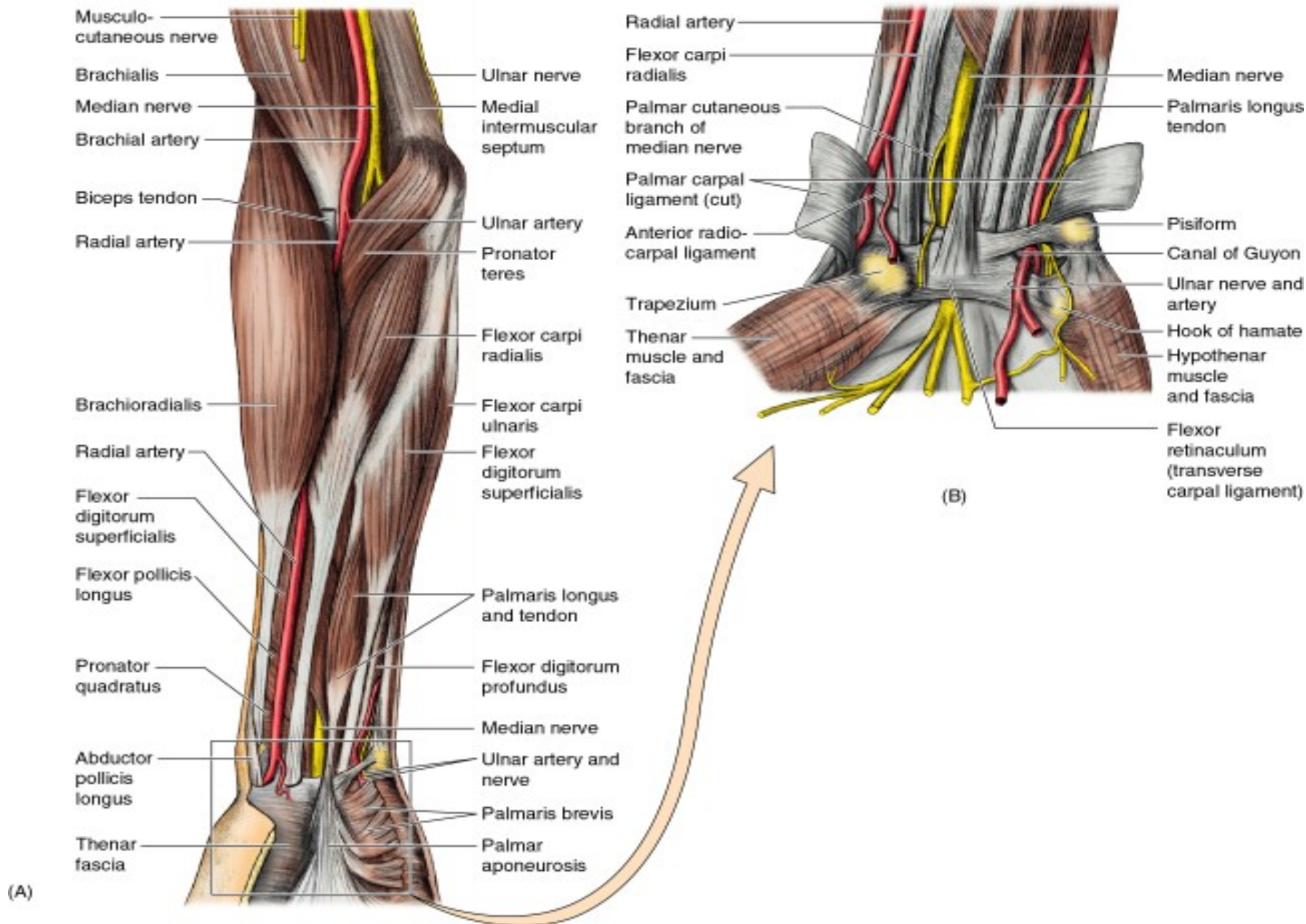


**Figure 6.38. Surface anatomy of the cubital fossa, forearm, and hand.** The forearm and hand are pronated. The cubital fossa is a triangular intermuscular depression, which contains the biceps tendon, the termination of the brachial artery, and the formation of its accompanying veins, the commencement of the radial and ulnar arteries, and parts of the median and radial nerves.



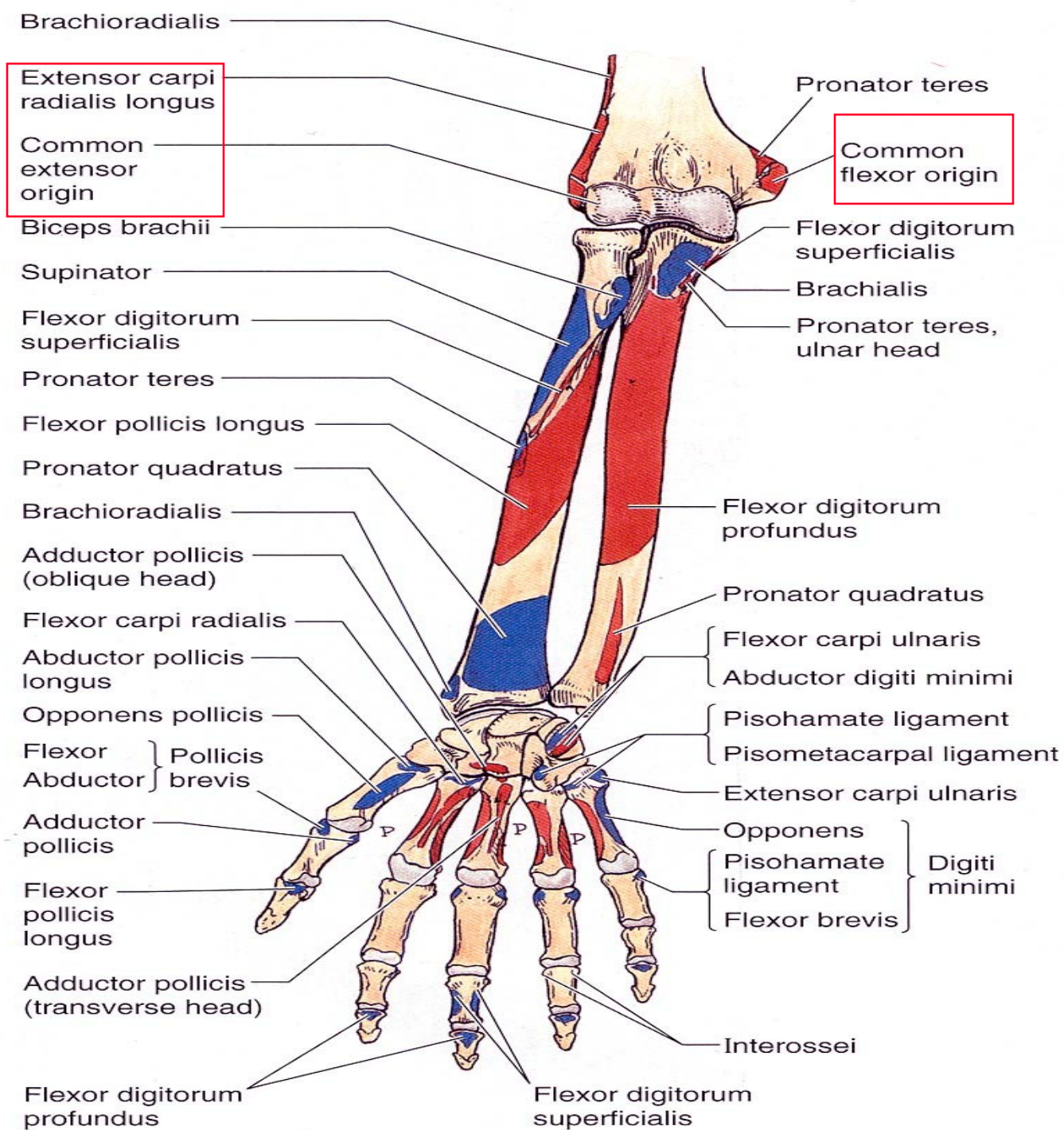


6.51A, B. Neurovascular structure in the anterior aspect of the forearm and wrist.



# **POINTS OF ORIGINS AND INSERTIONS**







Muscles of the  
Forearm:  
**Movements of  
the Wrist, Hand  
and Fingers**

# Movements of the Wrist, Hand & Fingers

- The forearm muscles are functionally divided into two groups:
  - Movers of the wrist
  - Movers of the fingers & thumb
- Their insertions are securely anchored by strong ligaments called **flexor & extensor retinacula.**

# Anterior Muscles

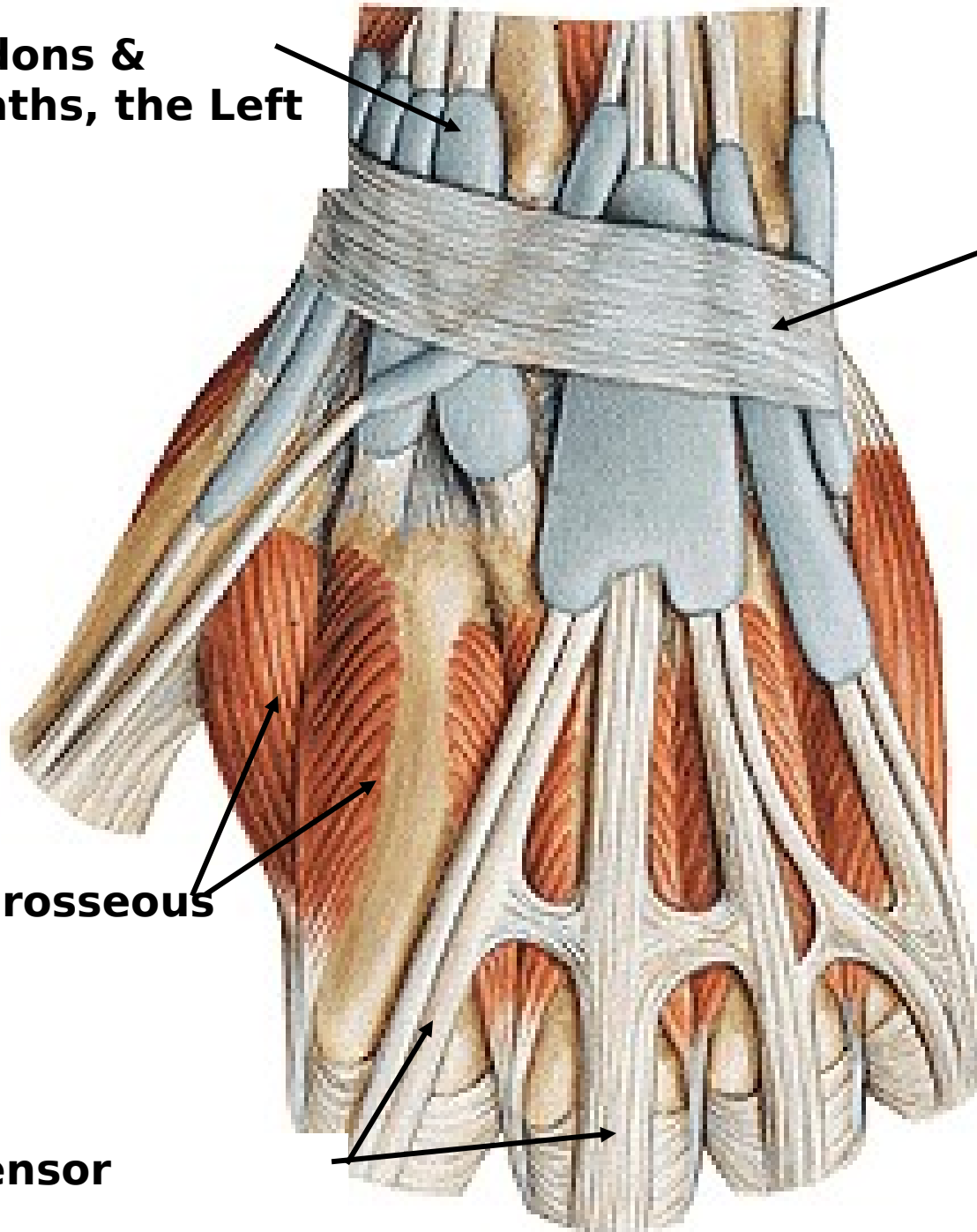
- The 5 muscles of the anterior fascial compartment arise from a common flexor tendon attached to the medial epicondyle.
- Most of these tendons are held in place at the wrist by a thickening of deep fascia – the **flexor retinaculum**

**Extensor Tendons &  
Synovial Sheaths, the Left  
Dorsal Wrist**

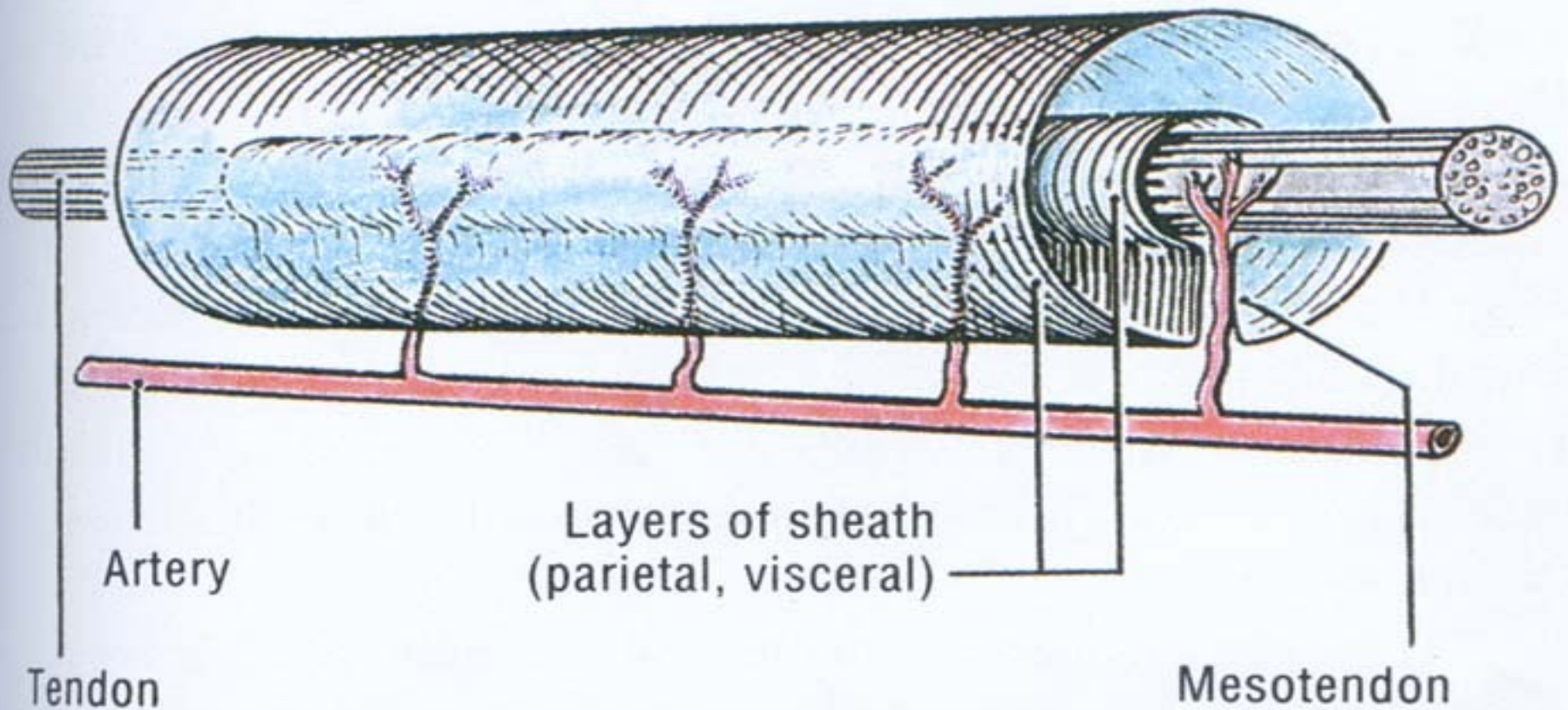
**Extensor  
retinacula**

**1<sup>st</sup> dorsal Interosseous  
m.**

**Tendons, extensor  
digitorum m.**



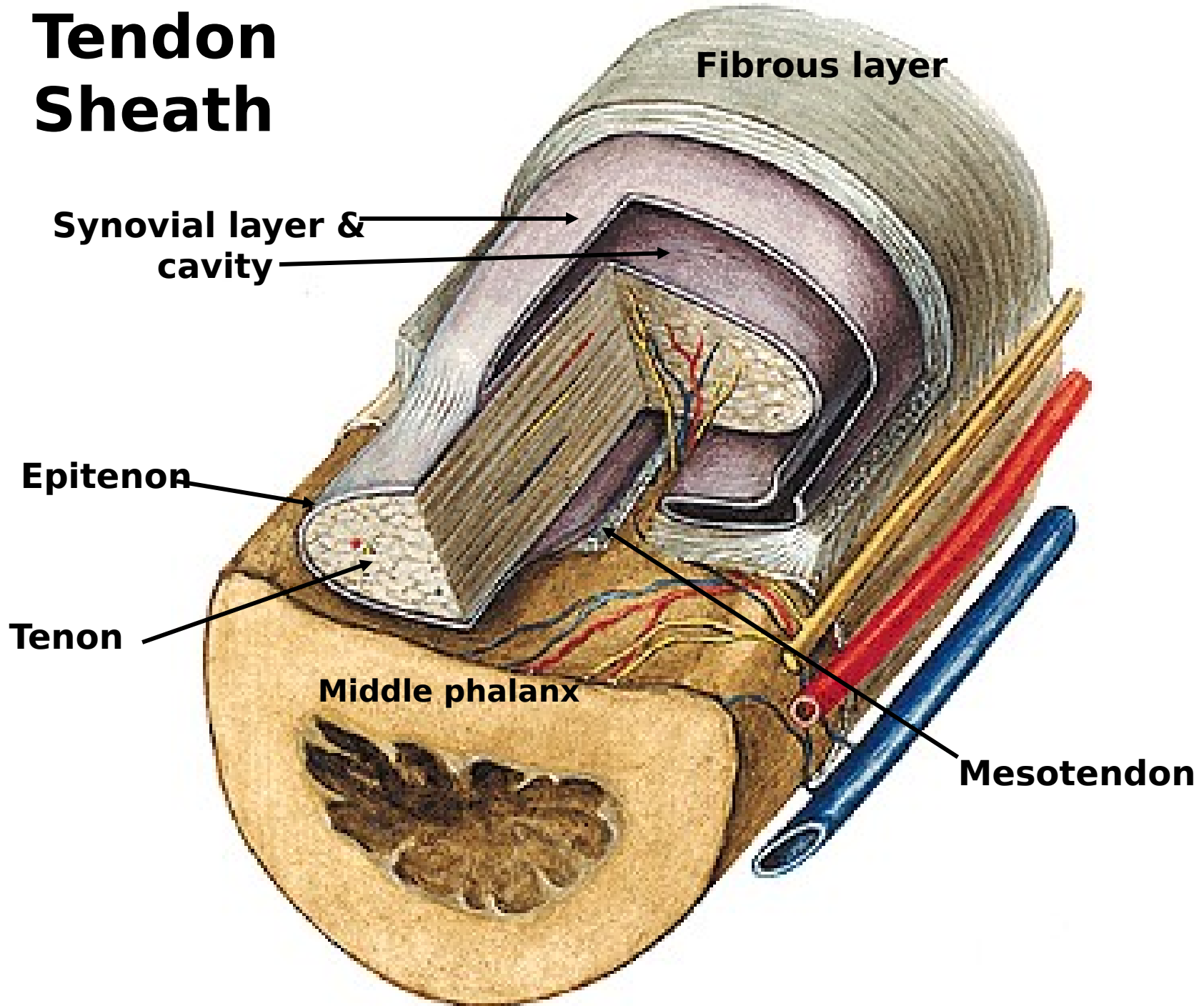
# **TENDON SHEATHS OF THE WRIST & HAND**



**Figure 6-79.** Synovial sheath of a long flexor tendon. The tubular sheath is a lubricating device (bursa) that envelops the long digital tendons where they pass through the osseofibrous tunnels in the digits (see Fig. 6-78). The layers of the synovial sheath are separated by a capillary layer of synovial fluid. Note that the mesotendon conveys small blood vessels to the tendons.



# Tendon Sheath

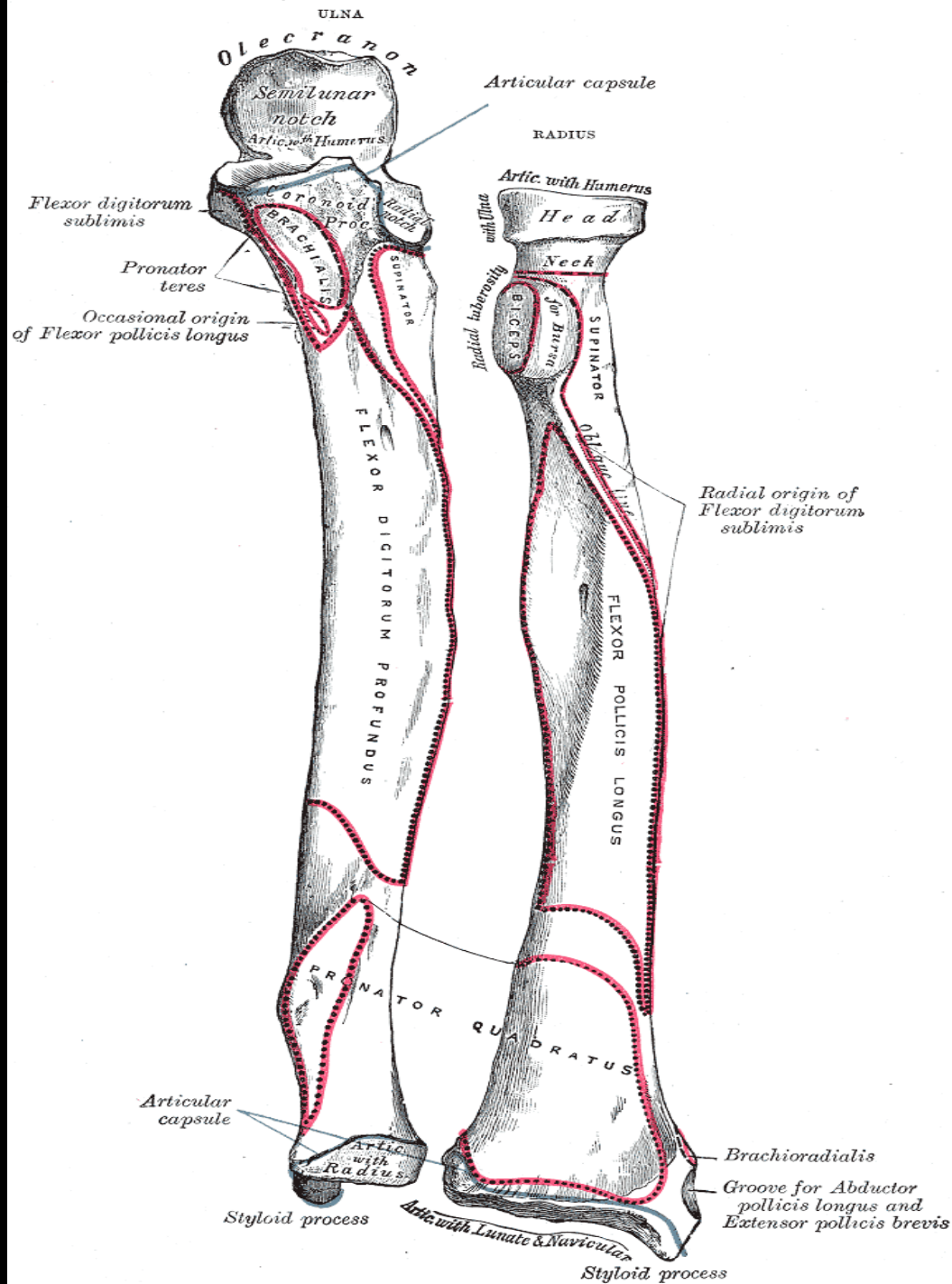


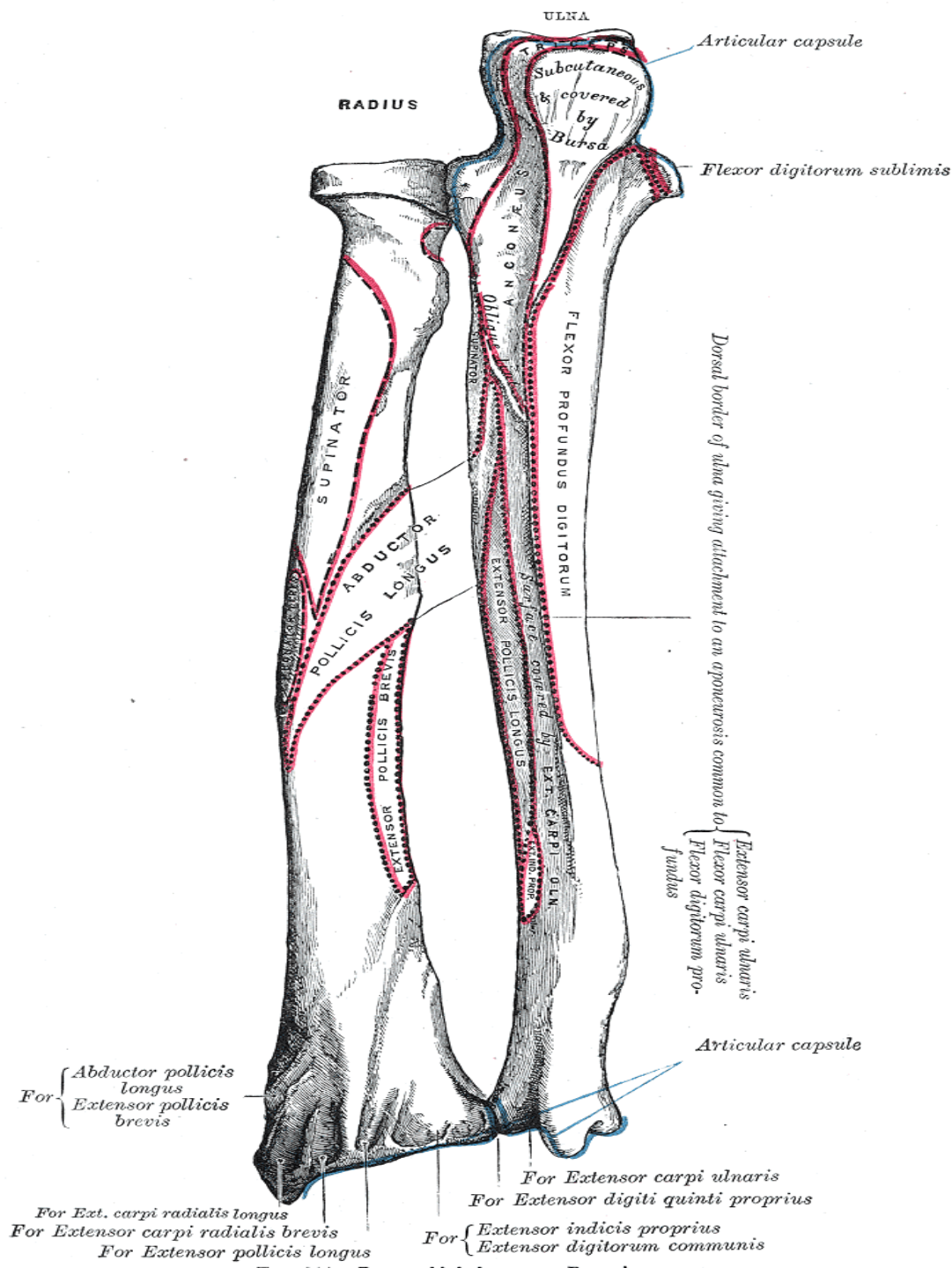
# Muscles Of The Forearm

- Anterior Flexor Muscles
  - Superficial & Deep muscles
  - Most flexors arise from a common tendon on the humerus
  - Most innervated by the median nerve
  - Most are wrist or finger flexors
  - Two are pronators - important Forearm movers




# Anterior Muscles

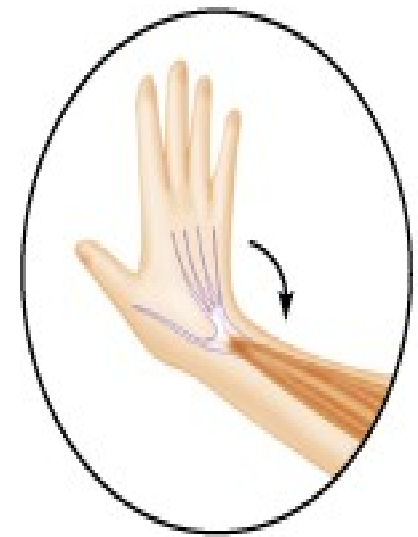
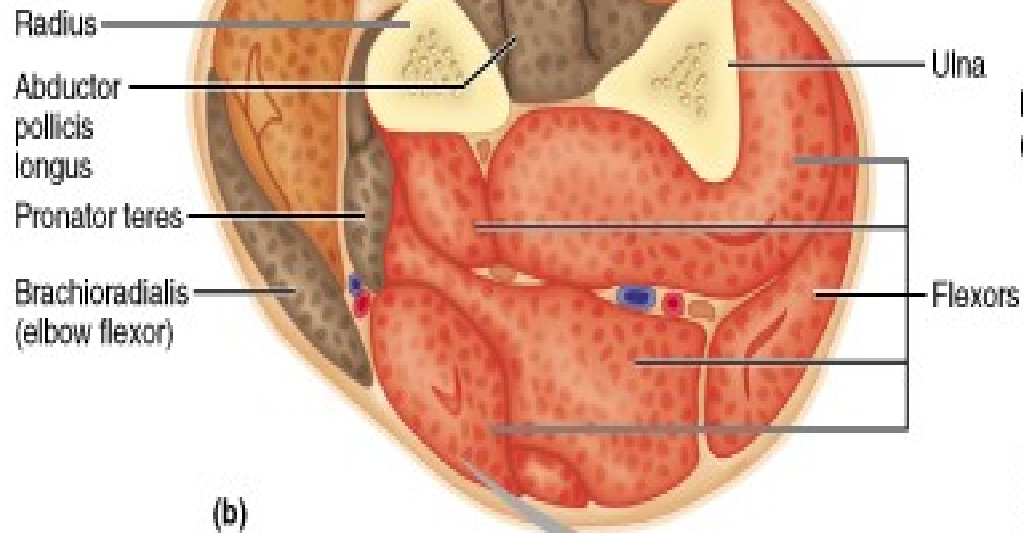
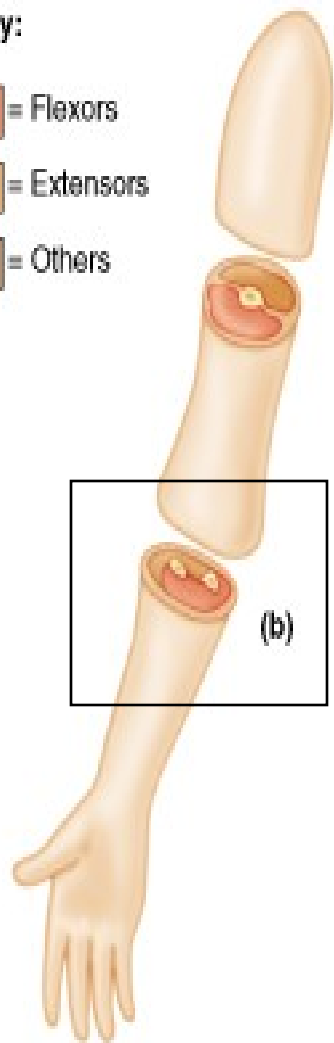
- Superficial Muscles (2 layers):
  - Pronator teres (not a flexor)
  - Flexor carpi radialis
  - Palmaris longus (weak flexor; tenses CT of palm)
  - Flexor carpi ulnaris
  - Flexor digitorum superficialis (2nd or middle layer)
- Deep Muscles (2 layers):
  - Flexor pollicis longus
  - Flexor digitorum profundus
  - Pronator quadratus



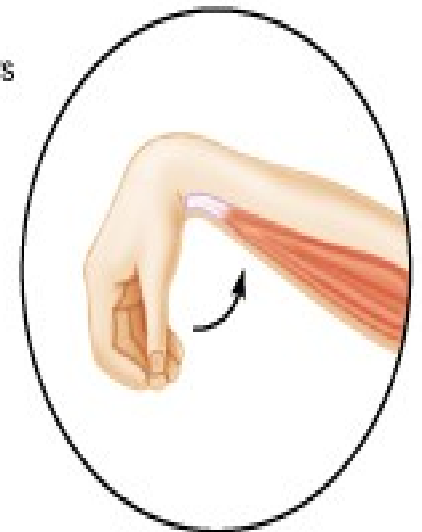


**Key:**

-  = Flexors
-  = Extensors
-  = Others



Posterior compartment of forearm  
(extends wrist and fingers)



Anterior compartment of forearm  
(flexes wrist and fingers)



## Key

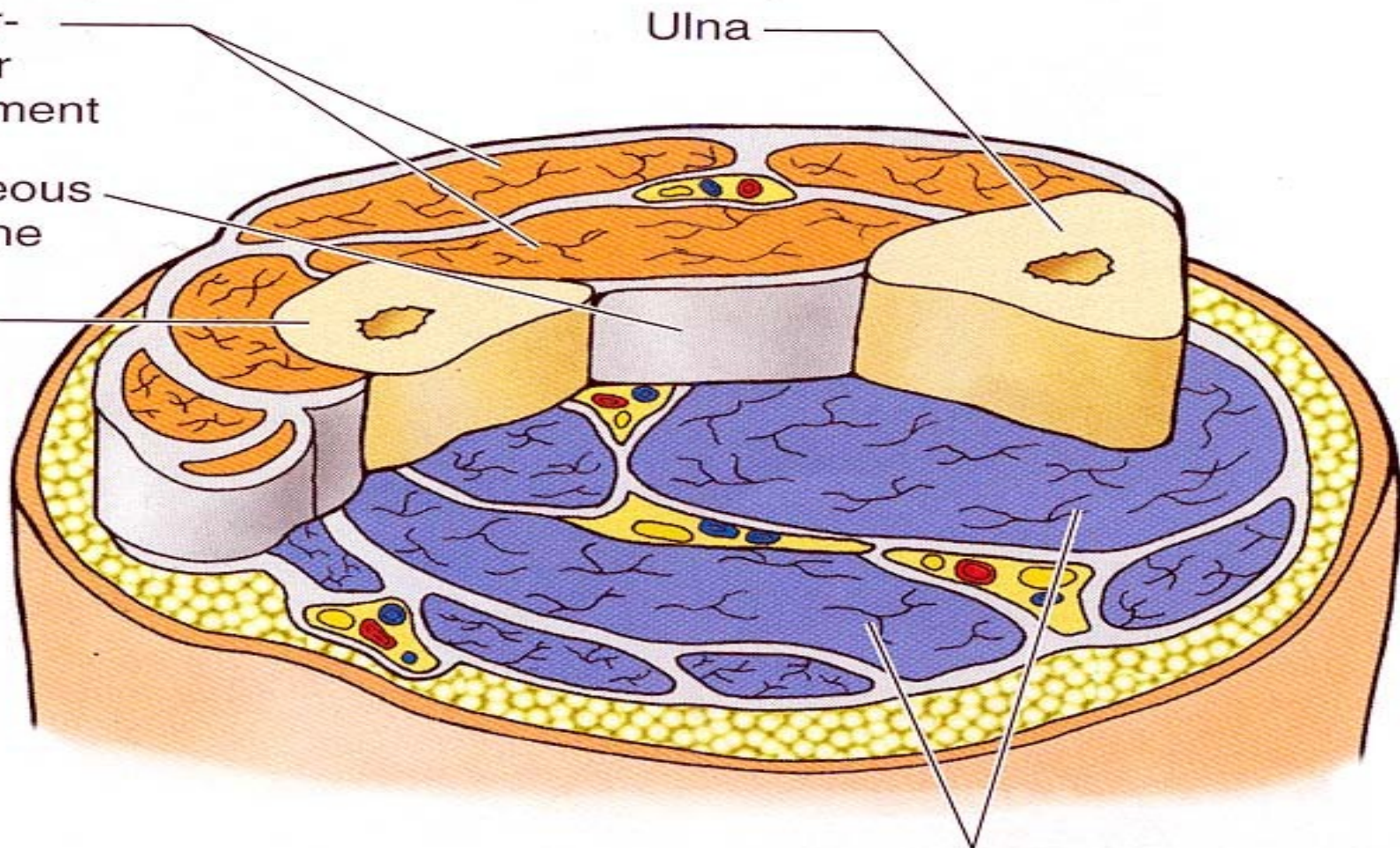
- Flexor
- Extensor

Extensor-supinator compartment

Interosseous membrane

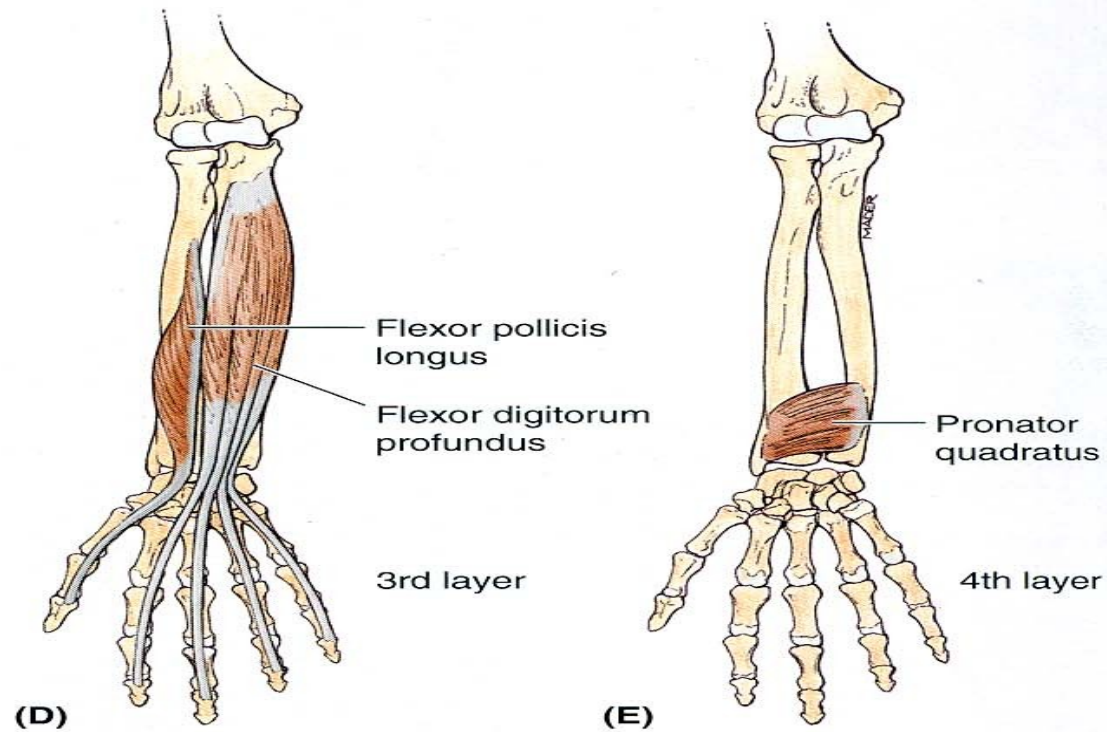
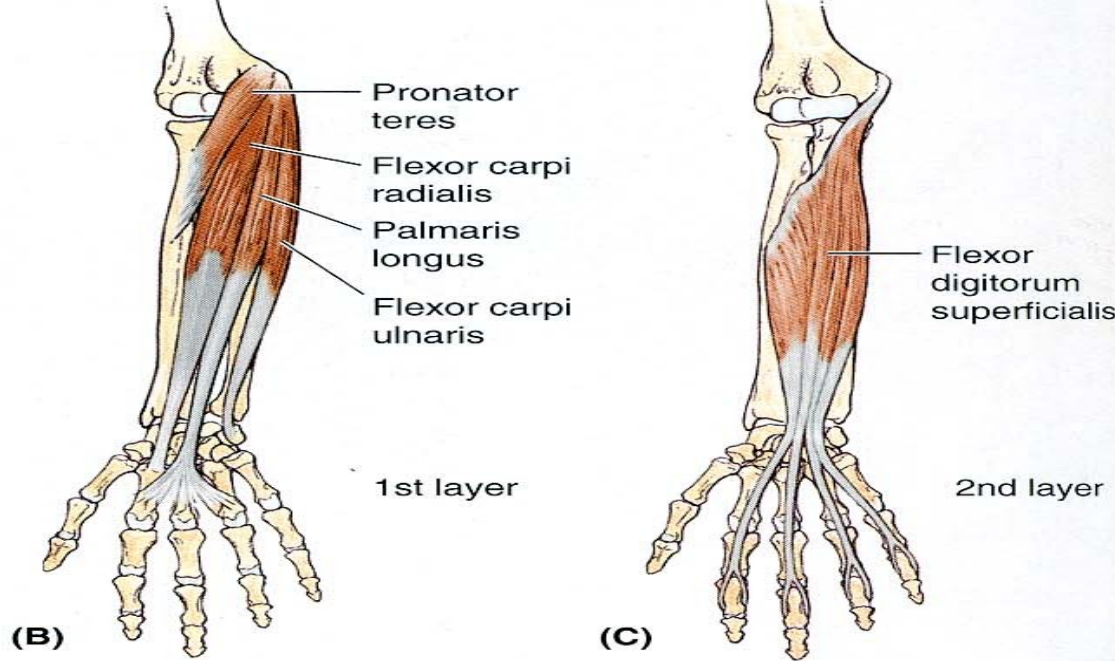
Radius

Ulna



Flexor pronator compartment

**(D) Anterior view**





Muscle	Proximal Attachment	Distal Attachment	Innervation <sup>a</sup>	Main Action
Pronator teres	Medial epicondyle of humerus and coronoid process of ulna	Middle of lateral surface of radius	Median nerve (C6 and <b>C7</b> )	Pronates and flexes forearm (at elbow)
Flexor carpi radialis	Medial epicondyle of humerus	Base of 2nd metacarpal bone		Flexes and abducts hand (at wrist)
Palmaris longus		Distal half of flexor retinaculum and palmar aponeurosis	Median nerve (C7 and C8)	Flexes hand (at wrist) and tightens palmar aponeurosis
Flexor carpi ulnaris	Humeral head: medial epicondyle of humerus Ulnar head: olecranon and posterior border of ulna	Pisiform bone, hook of hamate bone, and 5th metacarpal bone	Ulnar nerve (C7 and <b>C8</b> )	Flexes and adducts hand (at wrist)

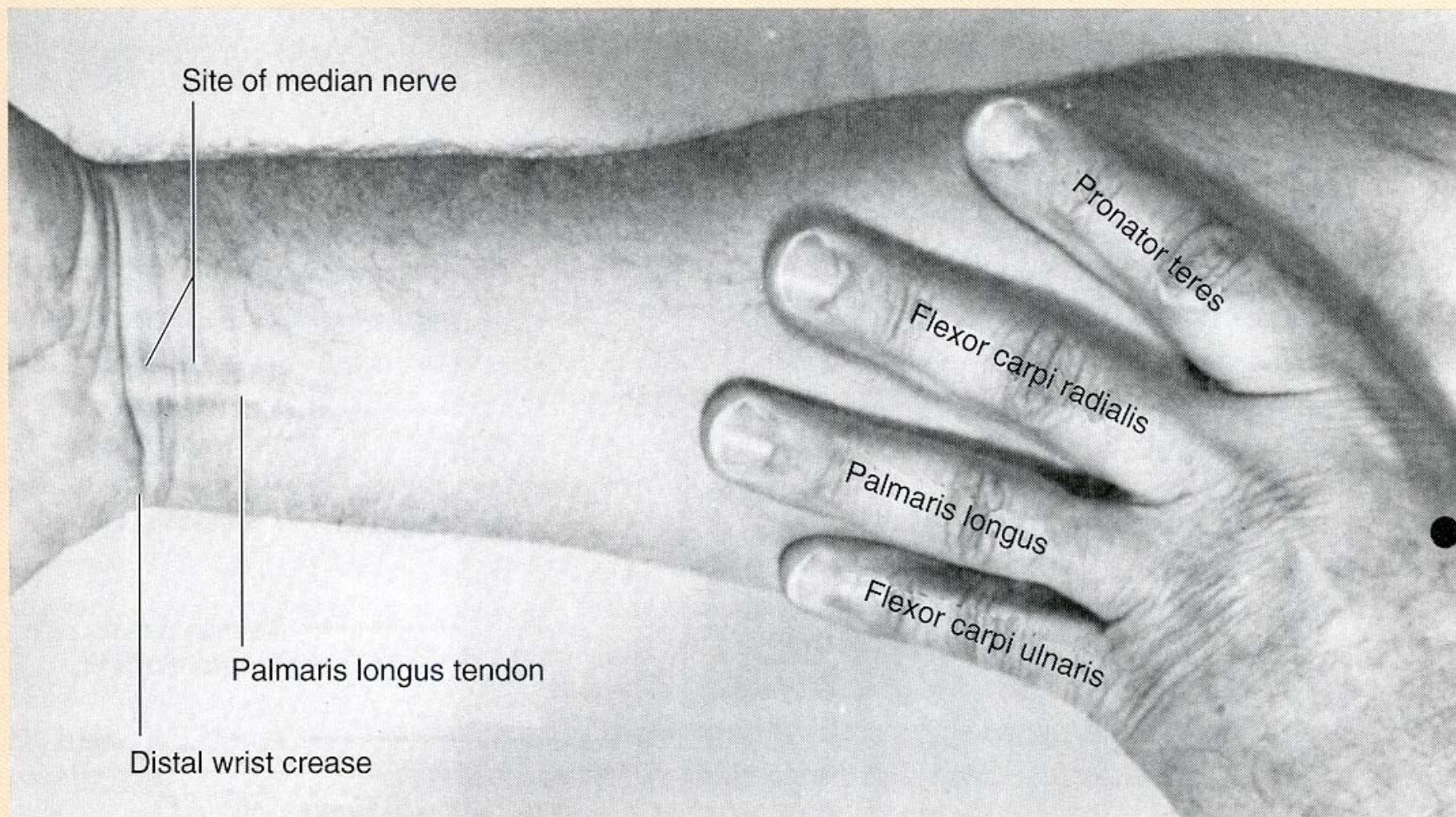


Muscle	Proximal Attachment	Distal Attachment	Innervation <sup>a</sup>	Main Action
Flexor digitorum superficialis	Humeroulnar head: medial epicondyle of humerus, ulnar collateral ligament, and coronoid process of ulna Radial head: superior half of anterior border of radius	Bodies of middle phalanges of medial four digits	Median nerve (C7, C8, and T1)	Flexes middle phalanges at proximal interphalangeal joints of medial four digits; acting more strongly, it also flexes proximal phalanges at metacarpophalangeal joints and hand
Flexor digitorum profundus	Proximal three-fourths of medial and anterior surfaces of ulna and interosseous membrane	Bases of distal phalanges of medial four digits	Medial part: ulnar nerve (C8 and T1) Lateral part: median nerve (C8 and T1)	Flexes distal phalanges at distal interphalangeal joints of medial four digits; assists with flexion of hand
Flexor pollicis longus	Anterior surface of radius and adjacent interosseous membrane	Base of distal phalanx of thumb	Anterior interosseous nerve from median (C8 and T1)	Flexes phalanges of 1st digit (thumb)
Pronator quadratus	Distal fourth of anterior surface of ulna	Distal fourth of anterior surface of radius		Pronates forearm; deep fibers bind radius and ulna together

# Anterior Muscles

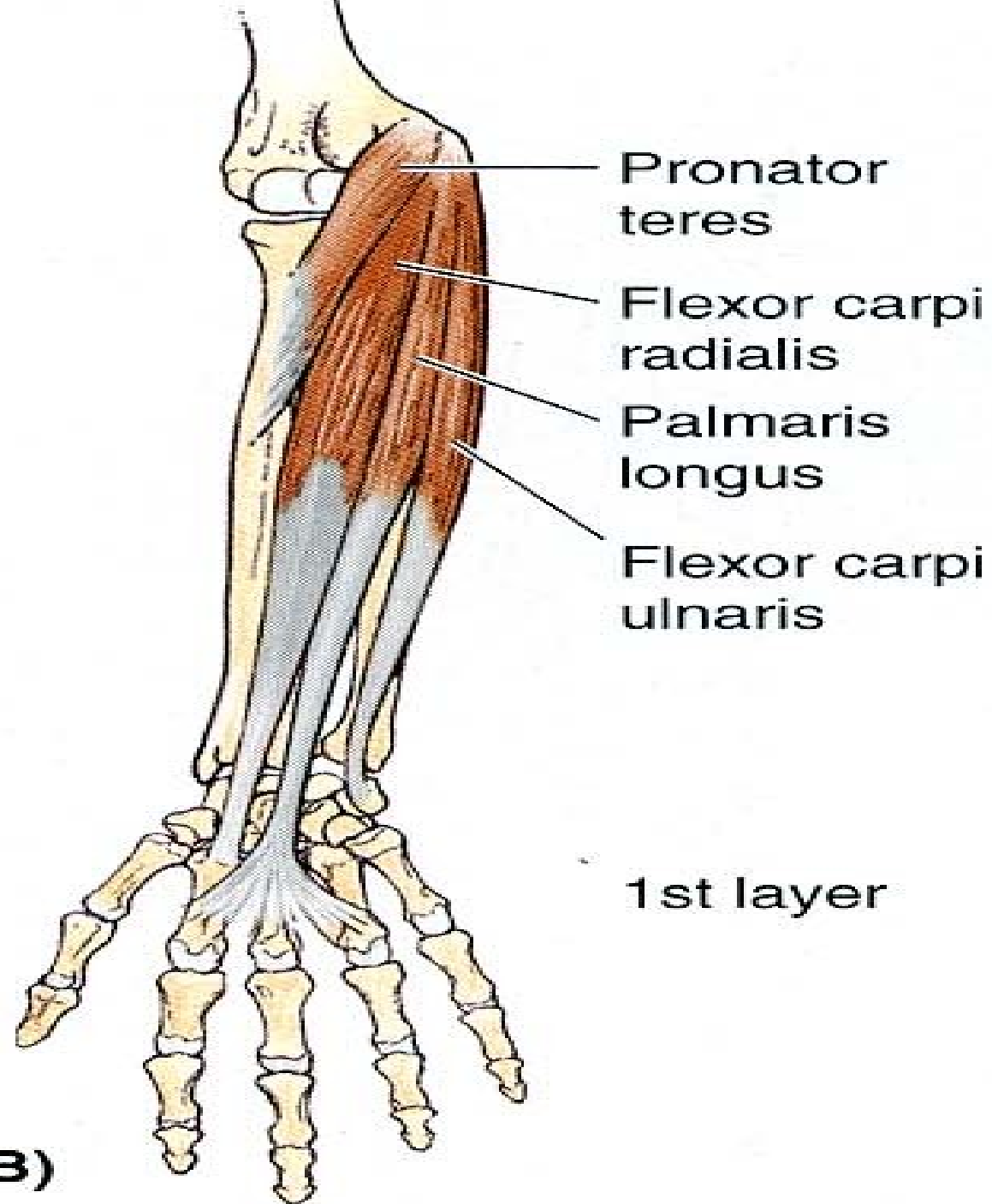
- Superficial Muscles or 1st Layer:
  - Pronator teres
  - Flexor carpi radialis
  - Palmaris longus
  - Flexor carpi ulnaris

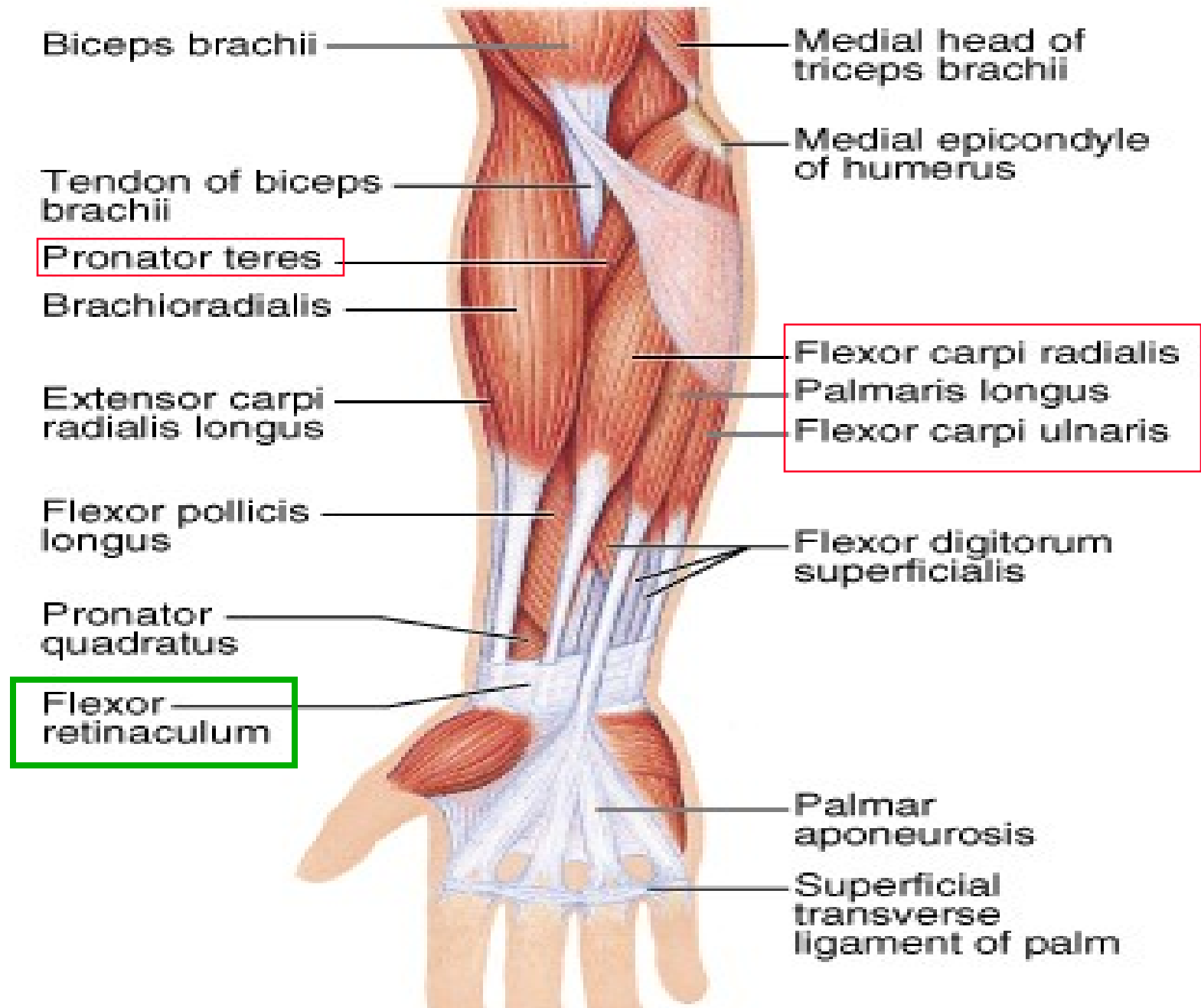




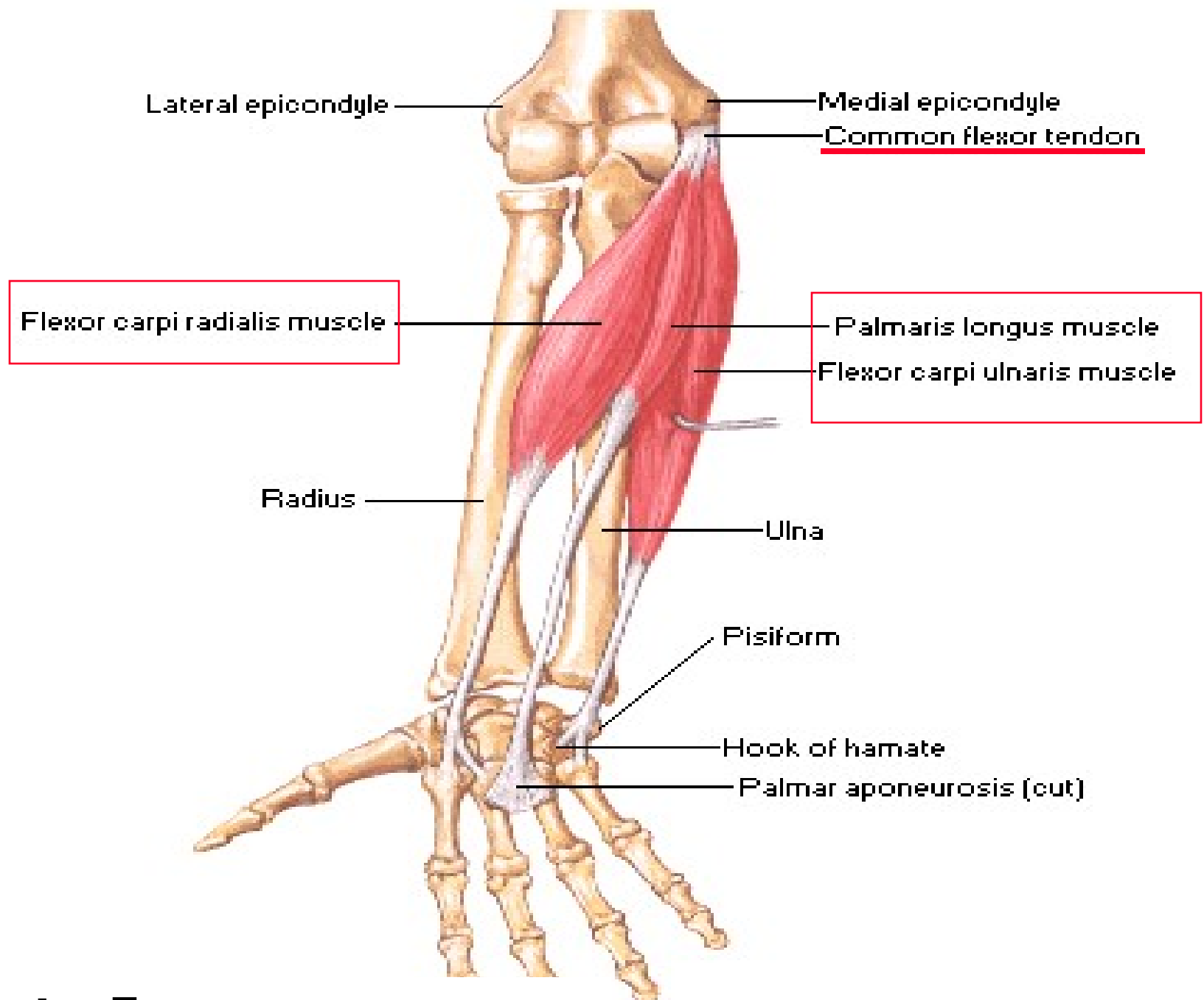








**Rt. Ant., Forearm,**



**Rt. Ant., Forearm,**

Triceps m. (medial head)

Medial brachial intermuscular septum

**Palmaris longus m.**

**Flexor carpi ulnaris m.**

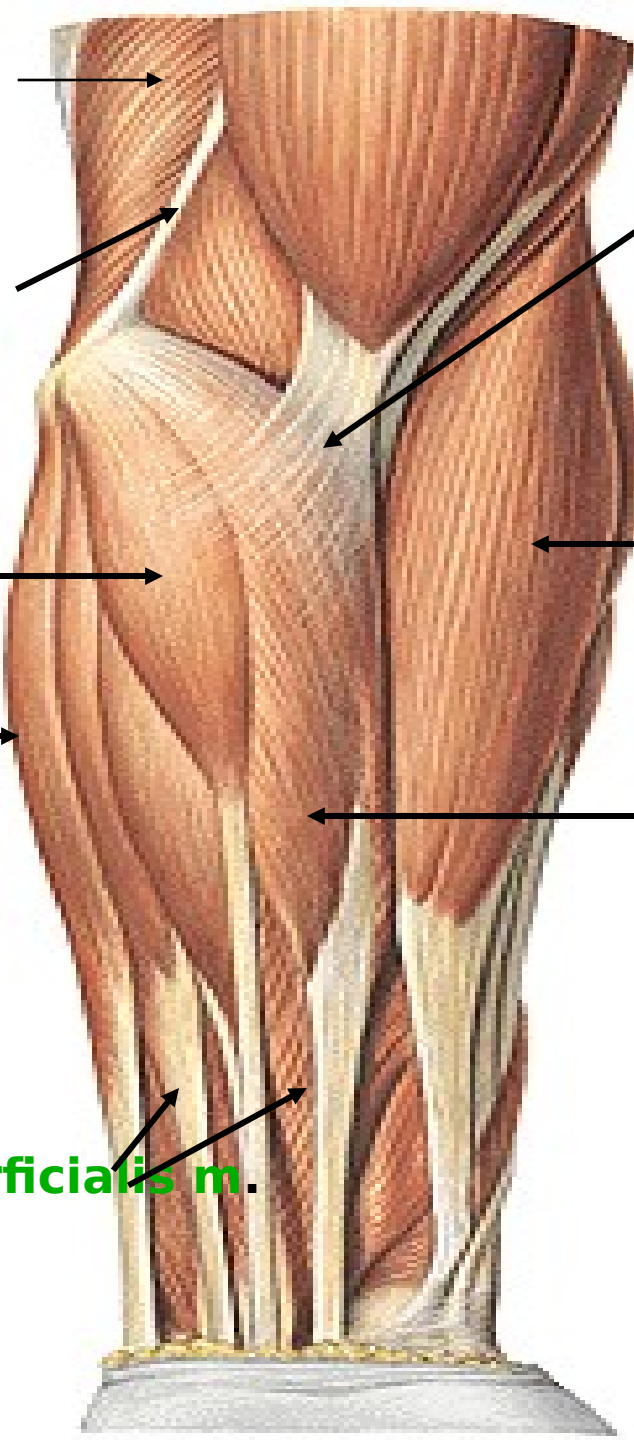
**Flexor digitorum superficialis m.**  
(2<sup>nd</sup> Layer)

Bicipital aponeurosis

**Brachioradialis m.**  
(a synergist in forearm flexion)

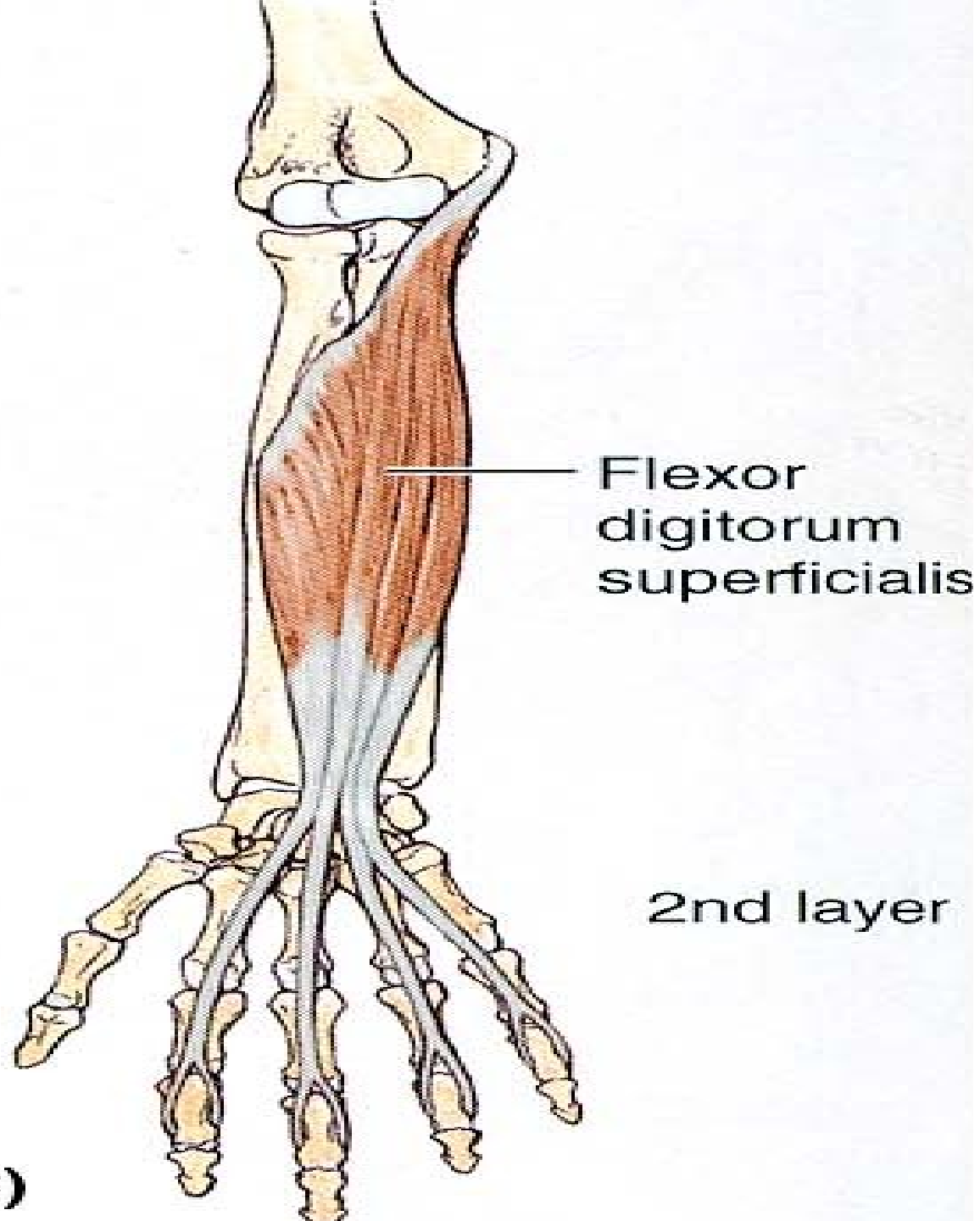
**Flexor carpi radialis m.**

**Lt. Forearm, Ant.  
Superficial m.  
1<sup>st</sup> Layer**

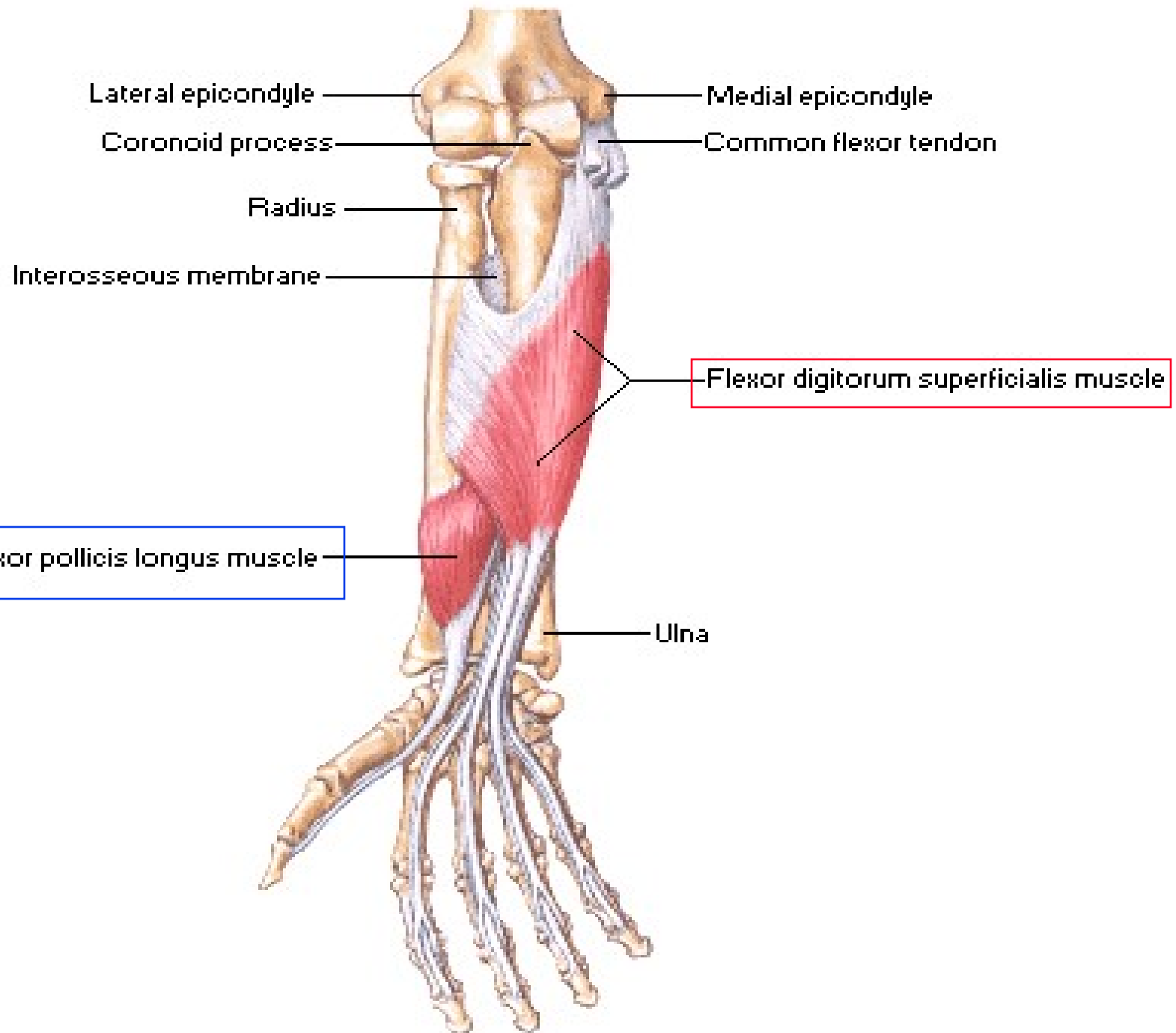


# Anterior Muscles

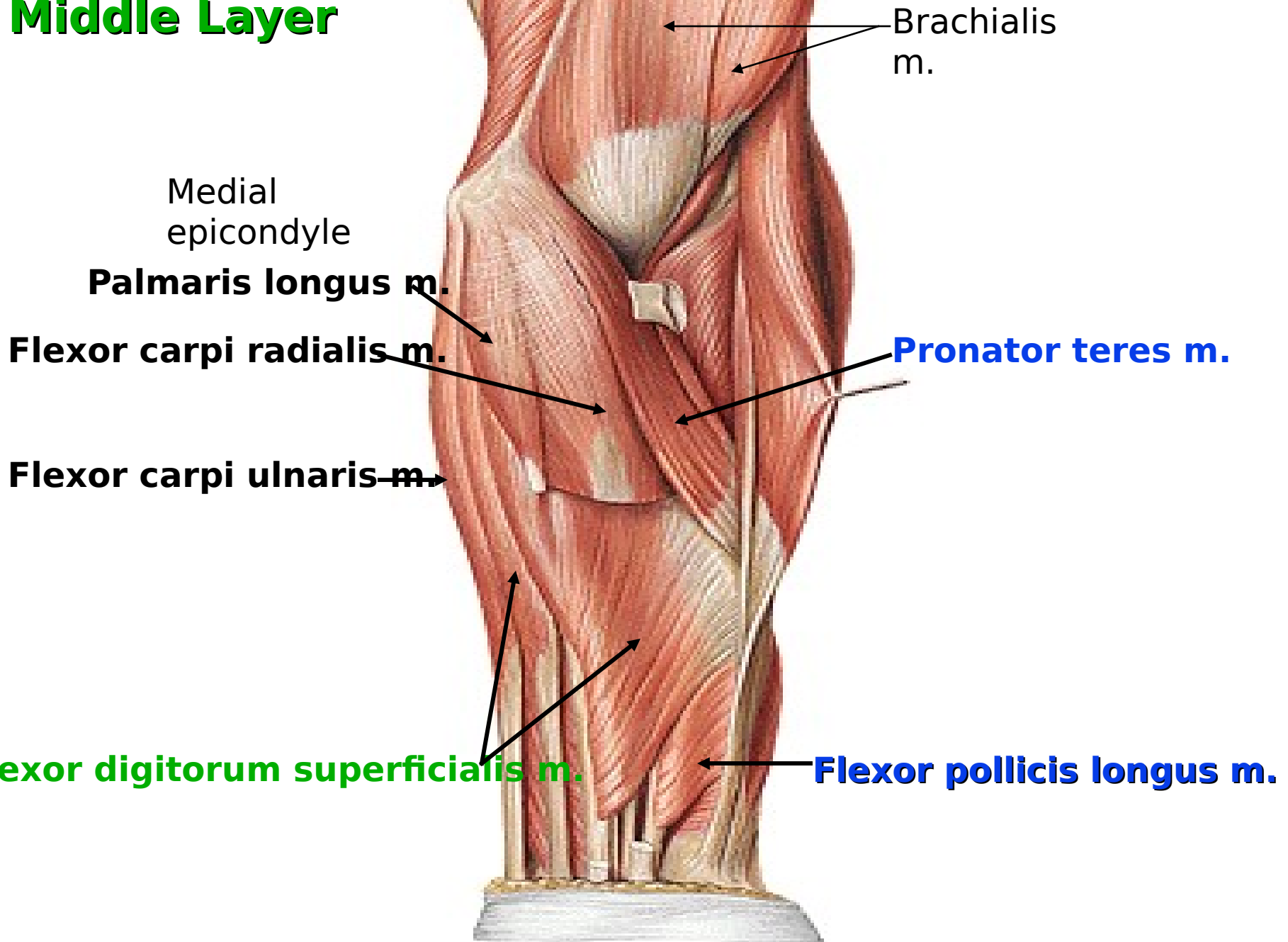
- Superficial Muscles or 2nd Layer:
  - Flexor digitorum superficialis  
(middle layer)





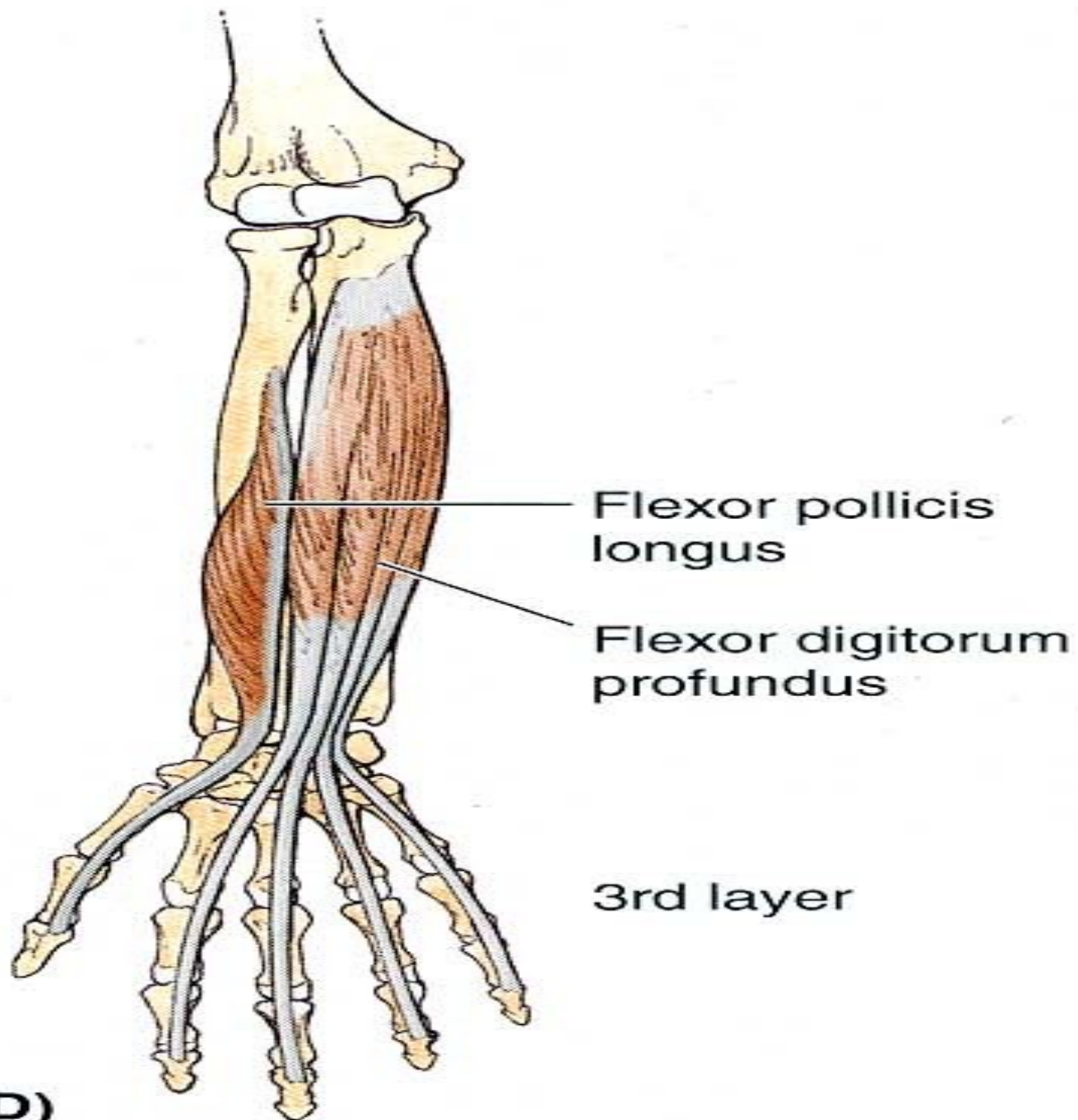


# Lt. Forearm, Ant., Middle Layer



# Anterior Muscles

- Deep Muscles:
  - Flexor pollicis longus
  - Flexor digitorum profundus
  - Pronator quadratus



## Deep muscles, **Ant. Rt. Forearm**

**A. Flexor digitorum profundus**



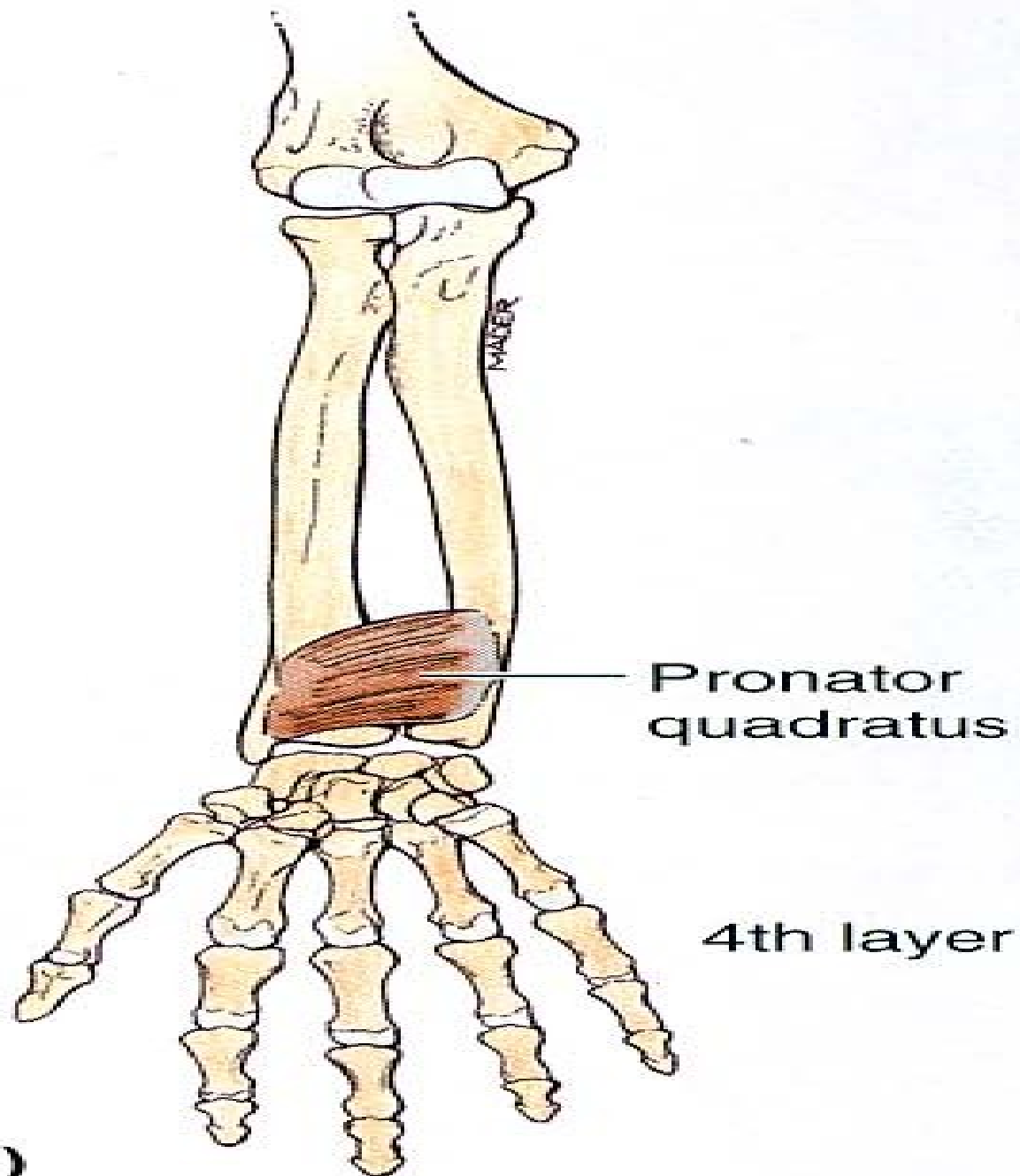
**B. Flexor pollicis longus**



**C. Pronator quadratus**



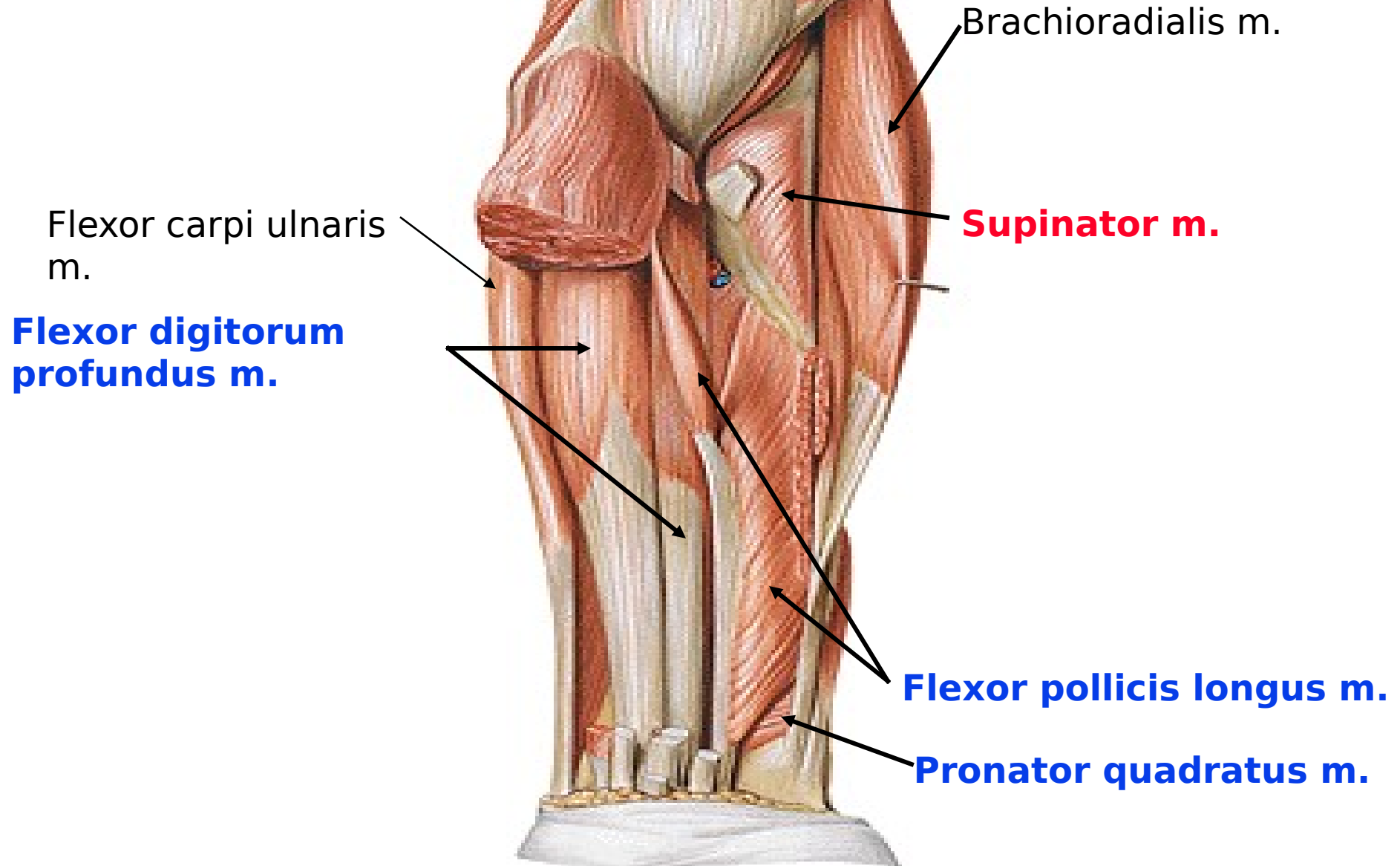
**Figure 6-80.** Deep muscles on the anterior aspect of the forearm. *A*, Flexor digitorum profundus. *B*, Flexor pollicis longus. *C*, Pronator quadratus.



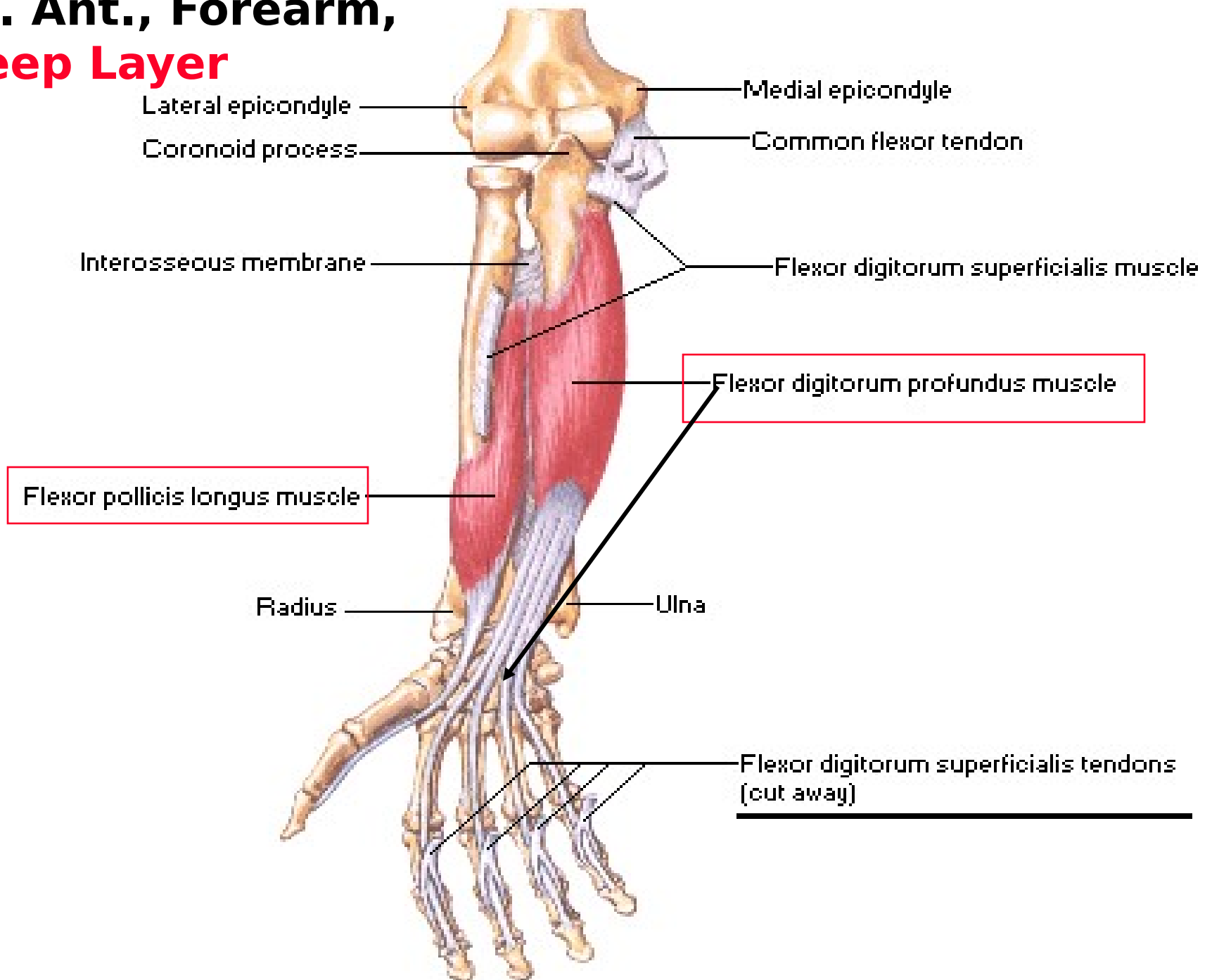
(E)



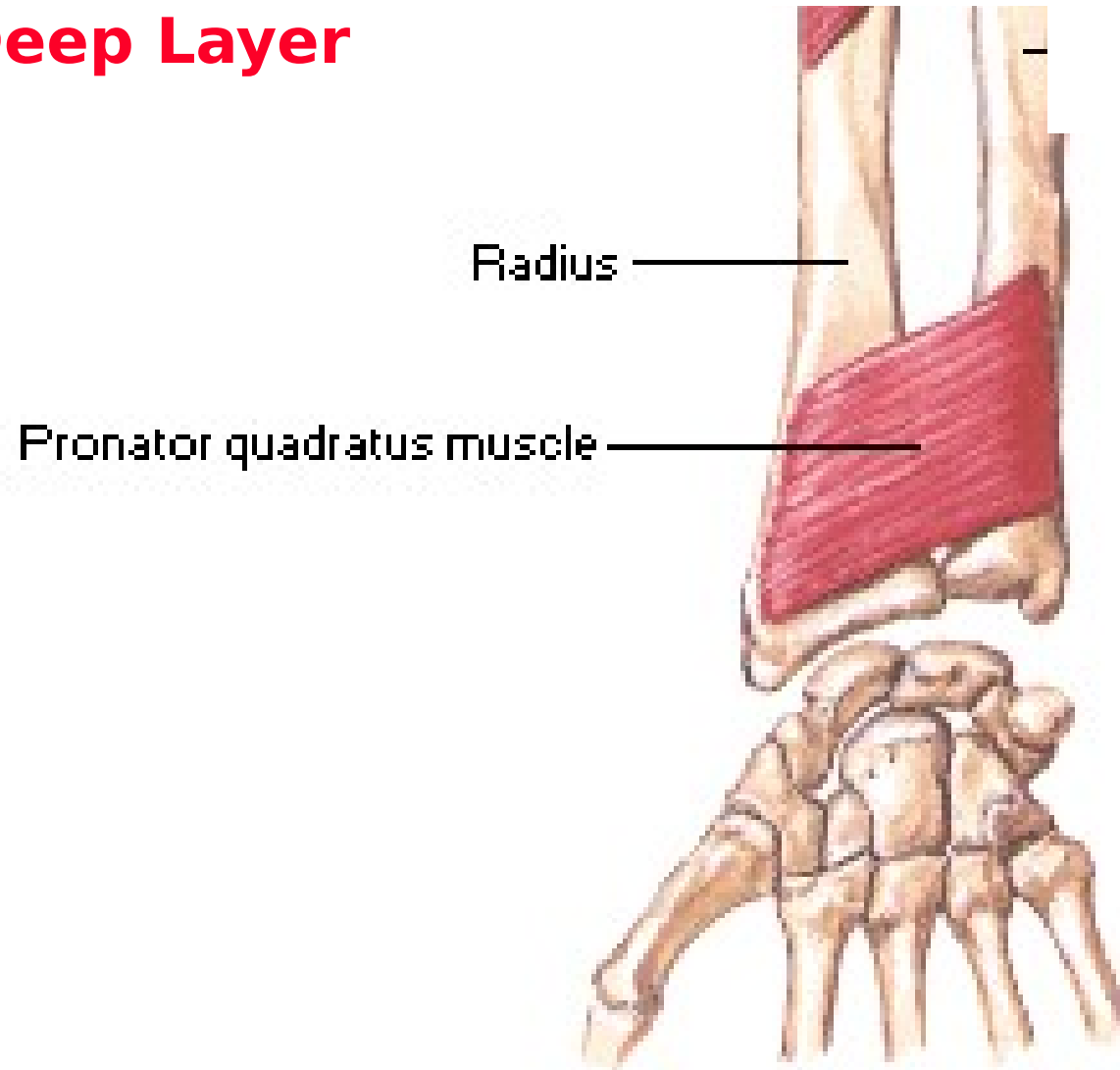
# Lt. Ant., Forearm, Deep Layer

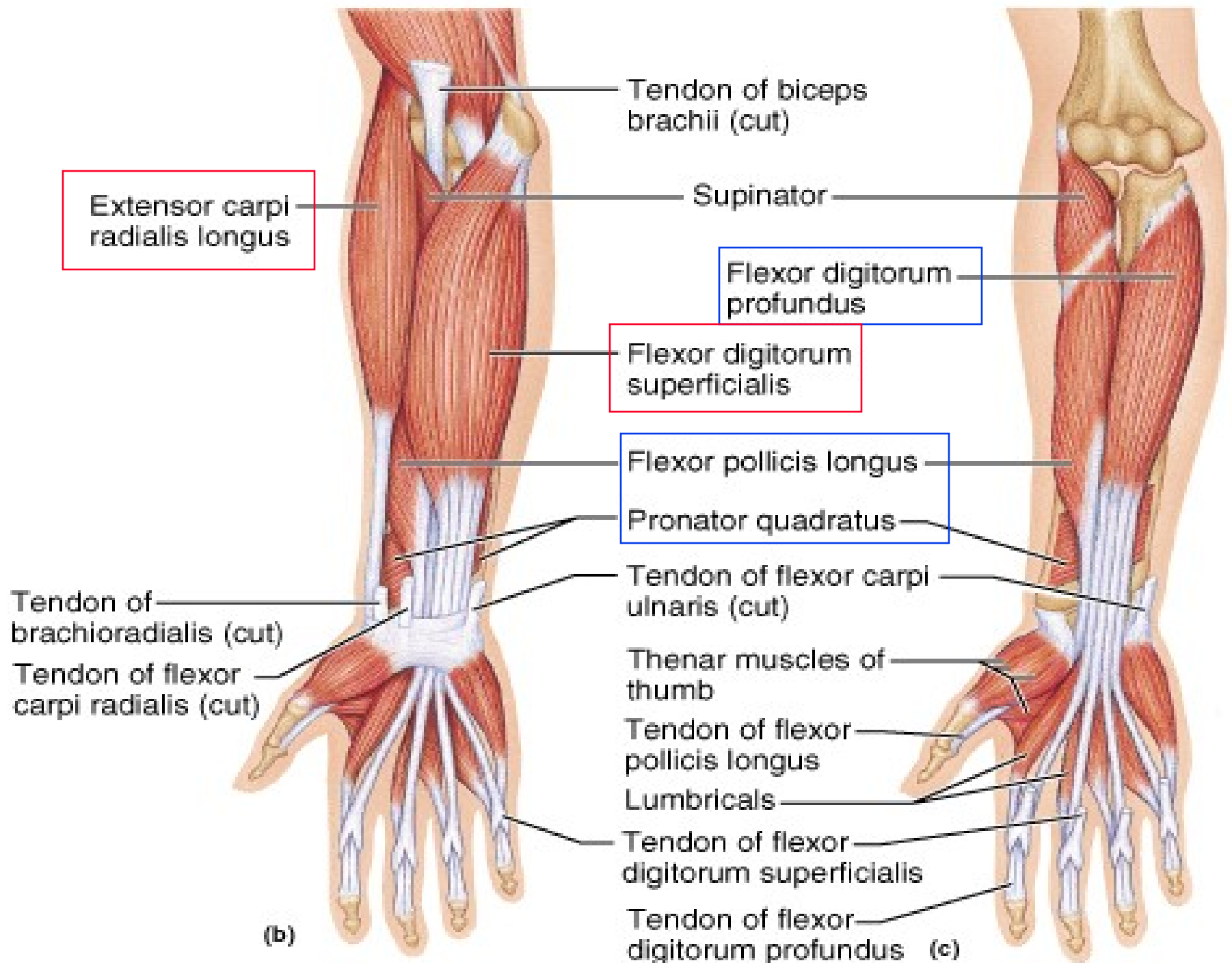


# Rt. Ant., Forearm, Deep Layer



# Rt. Ant., Forearm, Deep Layer





# Muscles Of The Forearm

- Posterior Extensors Muscles
  - Superficial muscles
  - Deep muscles
  - All innervated by the radial nerve or its branches
  - The extensor tendons are held in place at the wrist by the extensor retinaculum
  - The extensor muscles of the fingers end over the digits as the extensor expansion

# Posterior Muscles

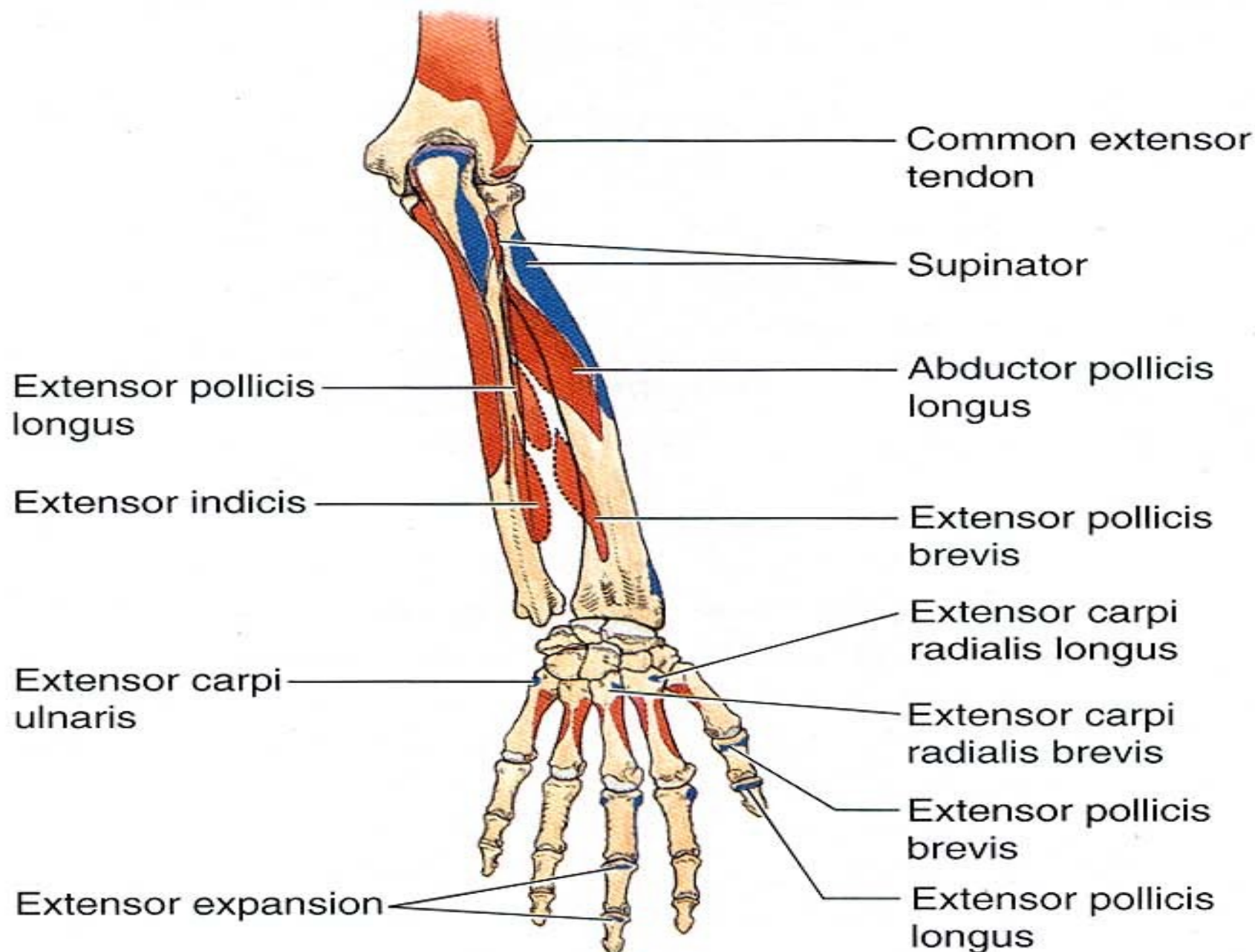
- **Superficial Muscles:**
  - Extensor carpi radialis longus
  - Extensor carpi radialis brevis
  - Extensor carpi ulnaris
  - Extensor digitorum
- **Deep Muscles:**
  - Supinator
  - Abductor pollicis longus
  - Extensor pollicis brevis & longus
  - Extensor indicis



# Posterior Muscles

- Superficial Muscles:
  - Extensor carpi radialis longus
  - Extensor carpi radialis brevis
  - Extensor carpi ulnaris
  - Extensor digitorum

**Table 6.7. Muscles of the Posterior Compartment of the Forearm**



Lateral supracondylar ridge

Brachioradialis

Lateral epicondyle

Common extensor tendon

Extensor carpi radialis longus

Extensor carpi radialis brevis

Extensor digitorum

Abductor pollicis longus

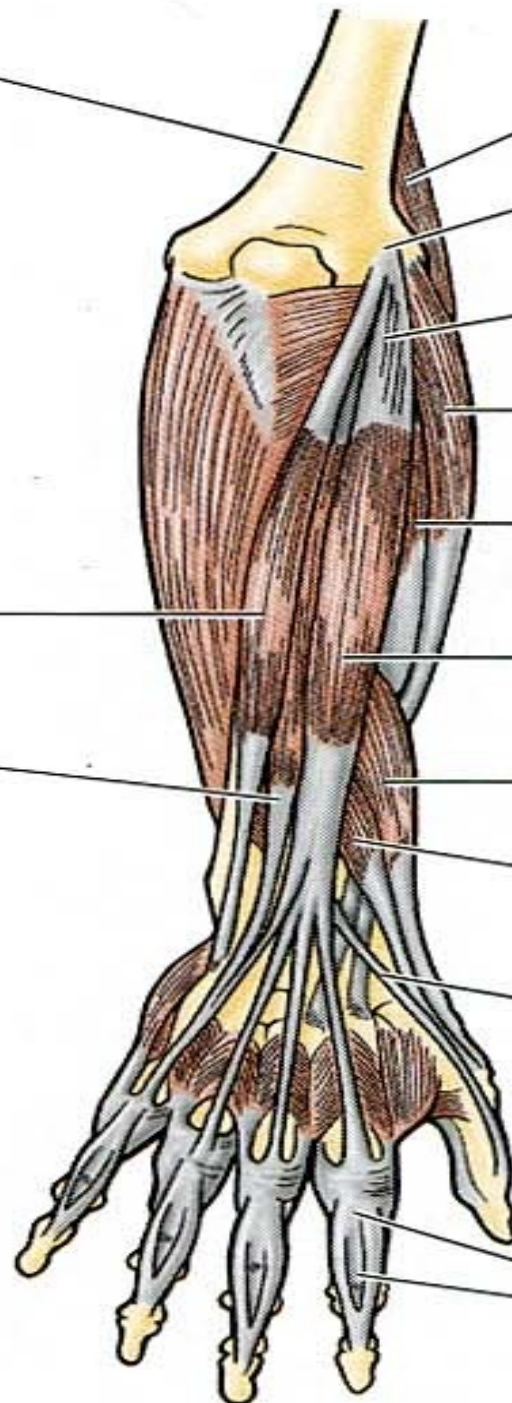
Extensor pollicis brevis

Extensor pollicis longus

Extensor carpi ulnaris

Extensor digiti minimi

Extensor expansion





Muscle	Proximal Attachment	Distal Attachment	Innervation <sup>a</sup>	Main Action
Extensor pollicis brevis	Posterior surface of radius and interosseous membrane	Base of proximal phalanx of thumb	Posterior interosseous nerve (C7 and <b>C8</b> ), the continuation of deep branch of radial nerve	Extends proximal phalanx of thumb at carpometacarpal joint
Extensor pollicis longus	Posterior surface of middle third of ulna and interosseous membrane	Base of distal phalanx of thumb		Extends distal phalanx of thumb at metacarpophalangeal and interphalangeal joints
Extensor indicis	Posterior surface of ulna and interosseous membrane	Extensor expansion of 2nd digit		Extends 2nd digit and helps to extend hand

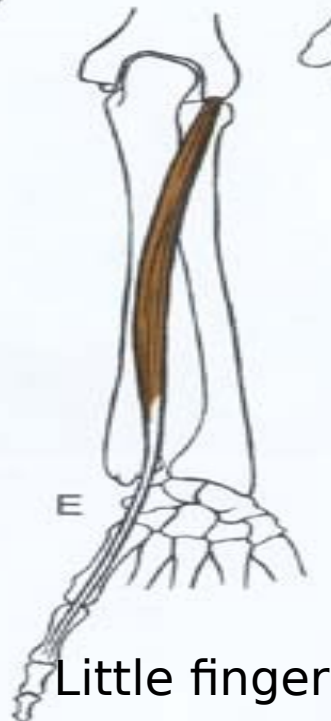
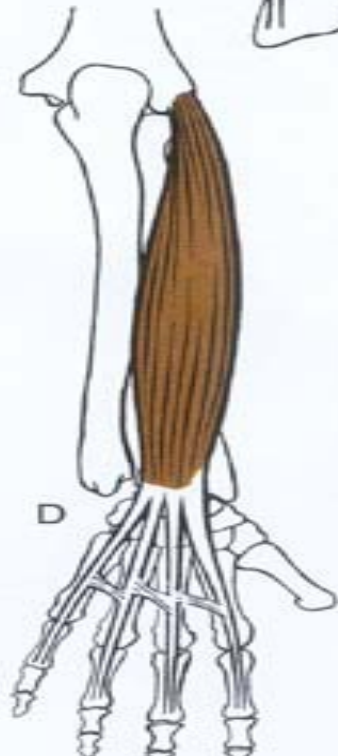
**Brachioradial  
is (flexes  
forearm)**



**Extensor  
carpi radialis  
longus**



**Extensor  
carpi radialis  
brevis**



**Anconeus  
(extends  
forearm)**

**Extensor  
digitorum**

**Extensor digit  
minimi**

**5<sup>th</sup>  
Extensor carpi  
ulnaris**

# Lt. Forearm, Posterolateral Superficial m.

**Extensor carpi  
radialis longus m.**

Lateral  
epicondyle

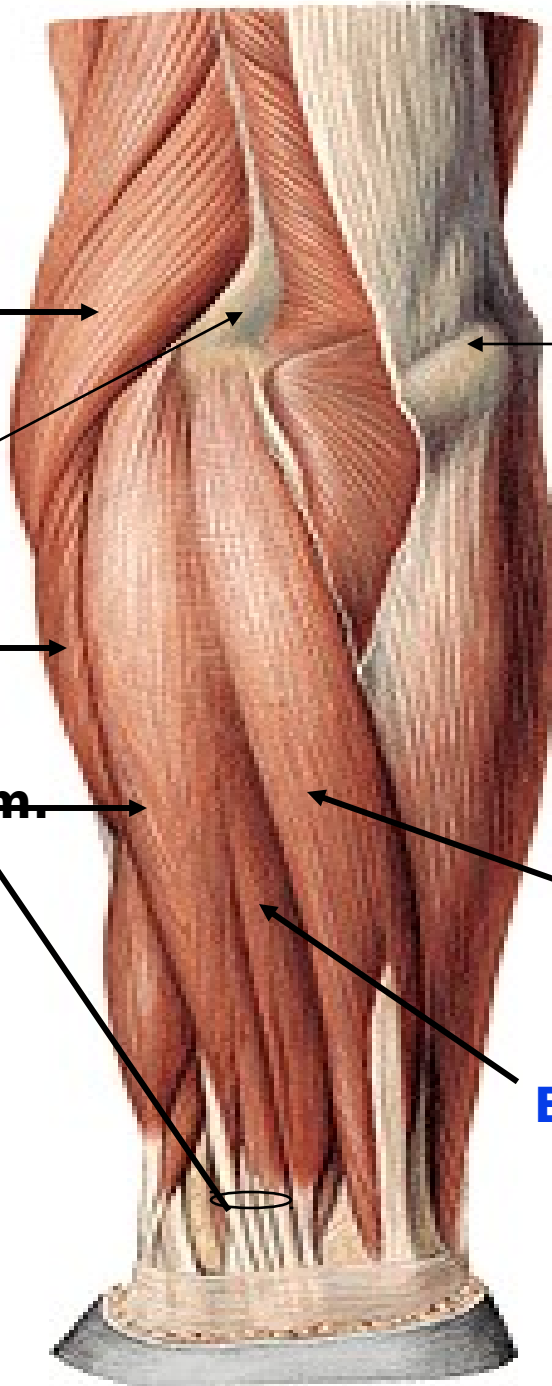
**Extensor carpi  
radialis brevis m.**

**Extensor digitorum m.**

Olecranon process

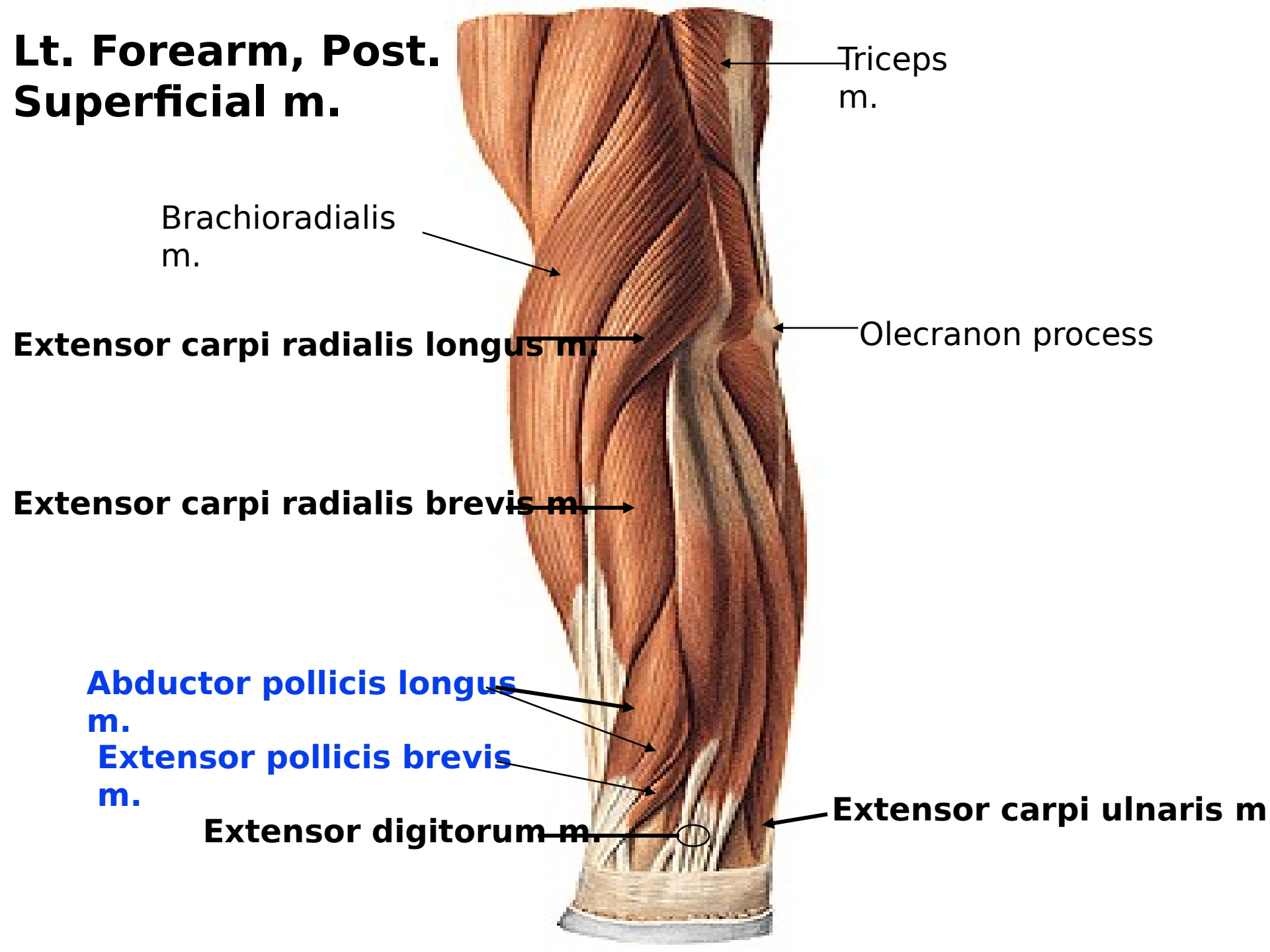
**Extensor carpi ulnaris m.**

**Extensor digiti minimi m.**





# Lt. Forearm, Post. Superficial m.



Triceps  
m.

Brachioradialis  
m.

**Extensor carpi radialis longus m.**

Olecranon process

**Extensor carpi radialis brevis m.**

**Abductor pollicis longus  
m.**

**Extensor pollicis brevis  
m.**

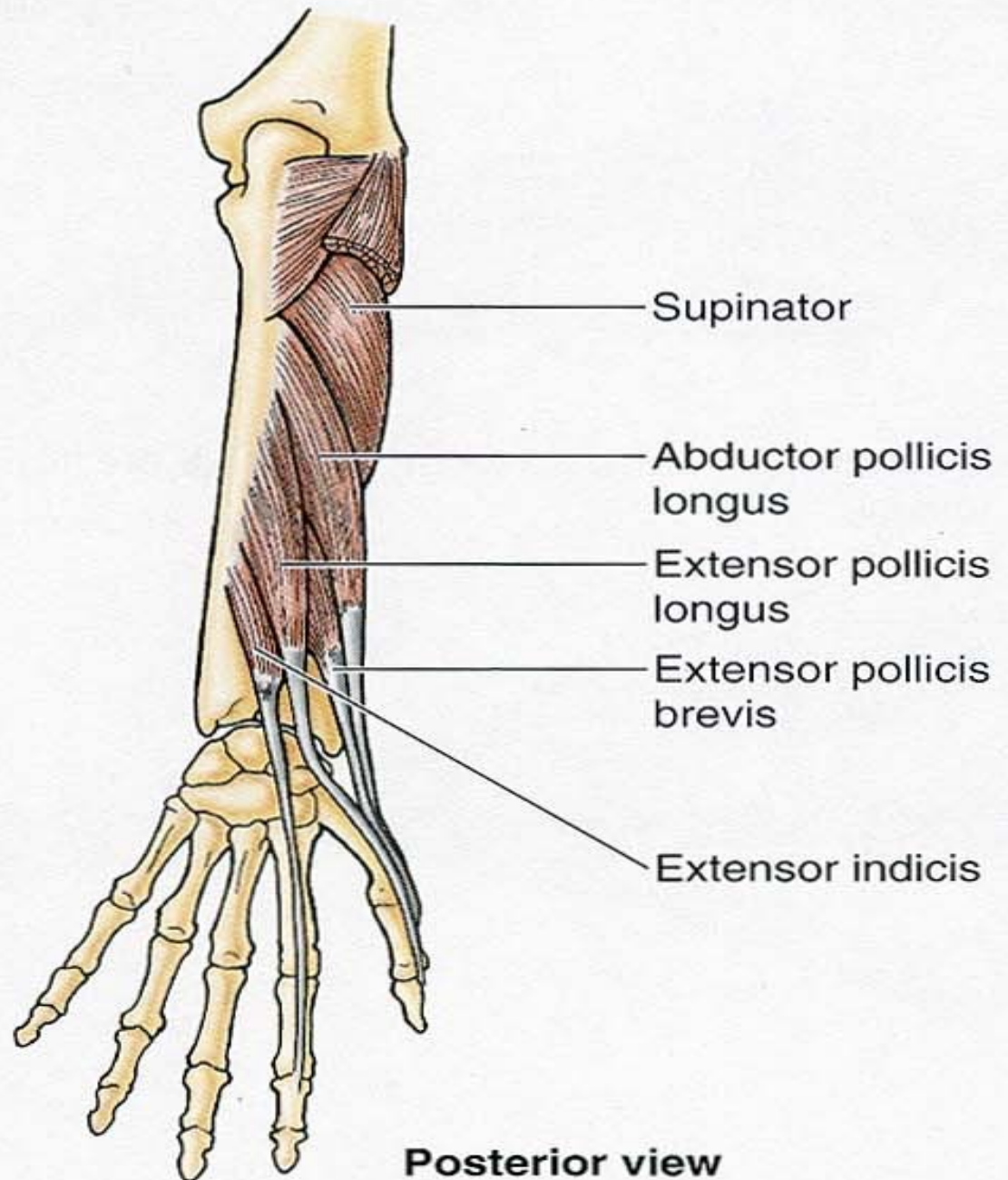
**Extensor digitorum m.**

**Extensor carpi ulnaris m**

# Posterior Muscles

- Deep Muscles:
  - Supinator
  - Abductor pollicis longus
  - Extensor pollicis longus
  - Extensor pollicis brevis
  - Extensor indicis

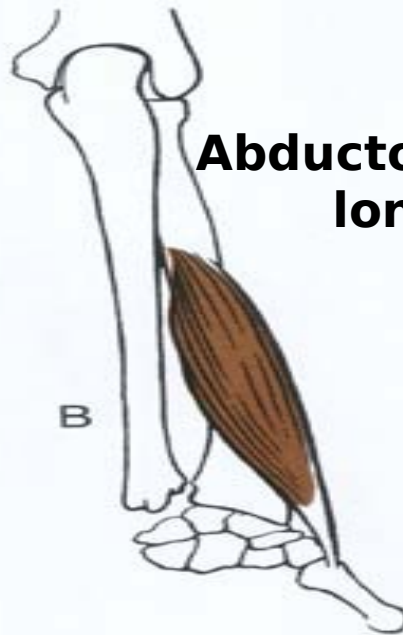
## Muscles of the Posterior Compartment of the Forearm





**Supinator**

A



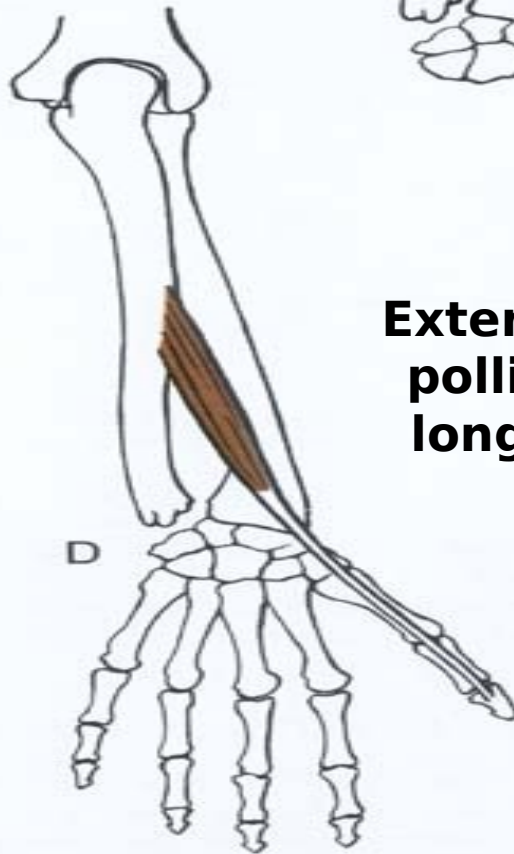
**Abductor pollicis longus**

B



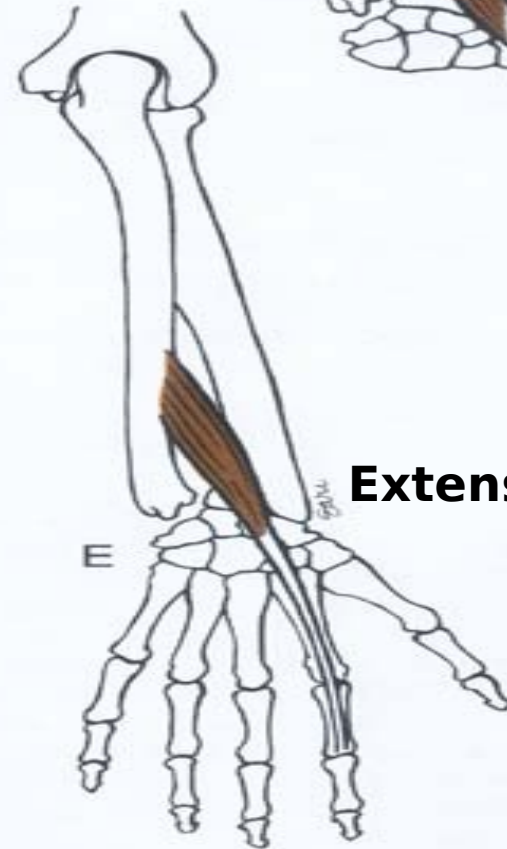
**Extensor pollicis brevis**

C



**Extensor pollicis longus**

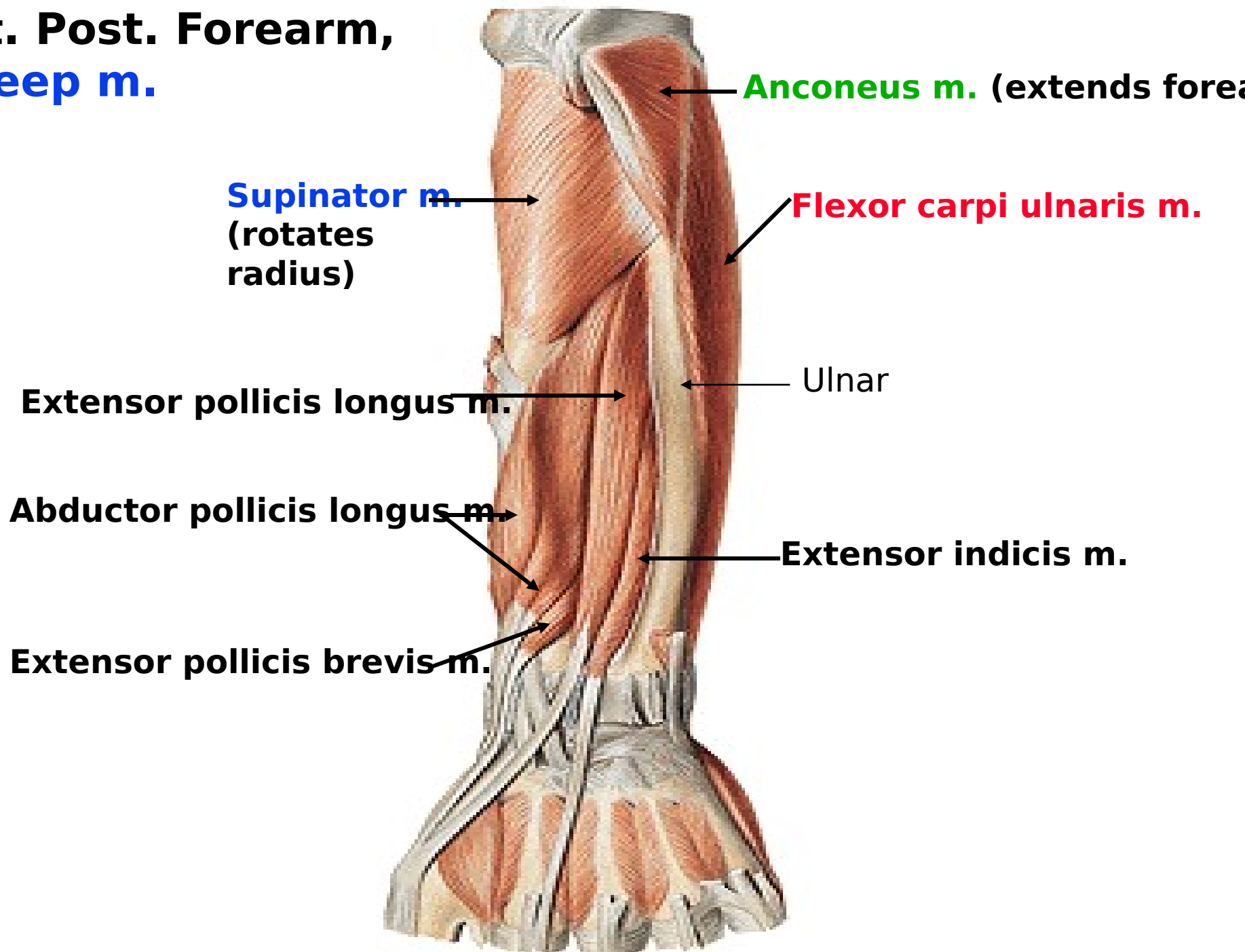
D

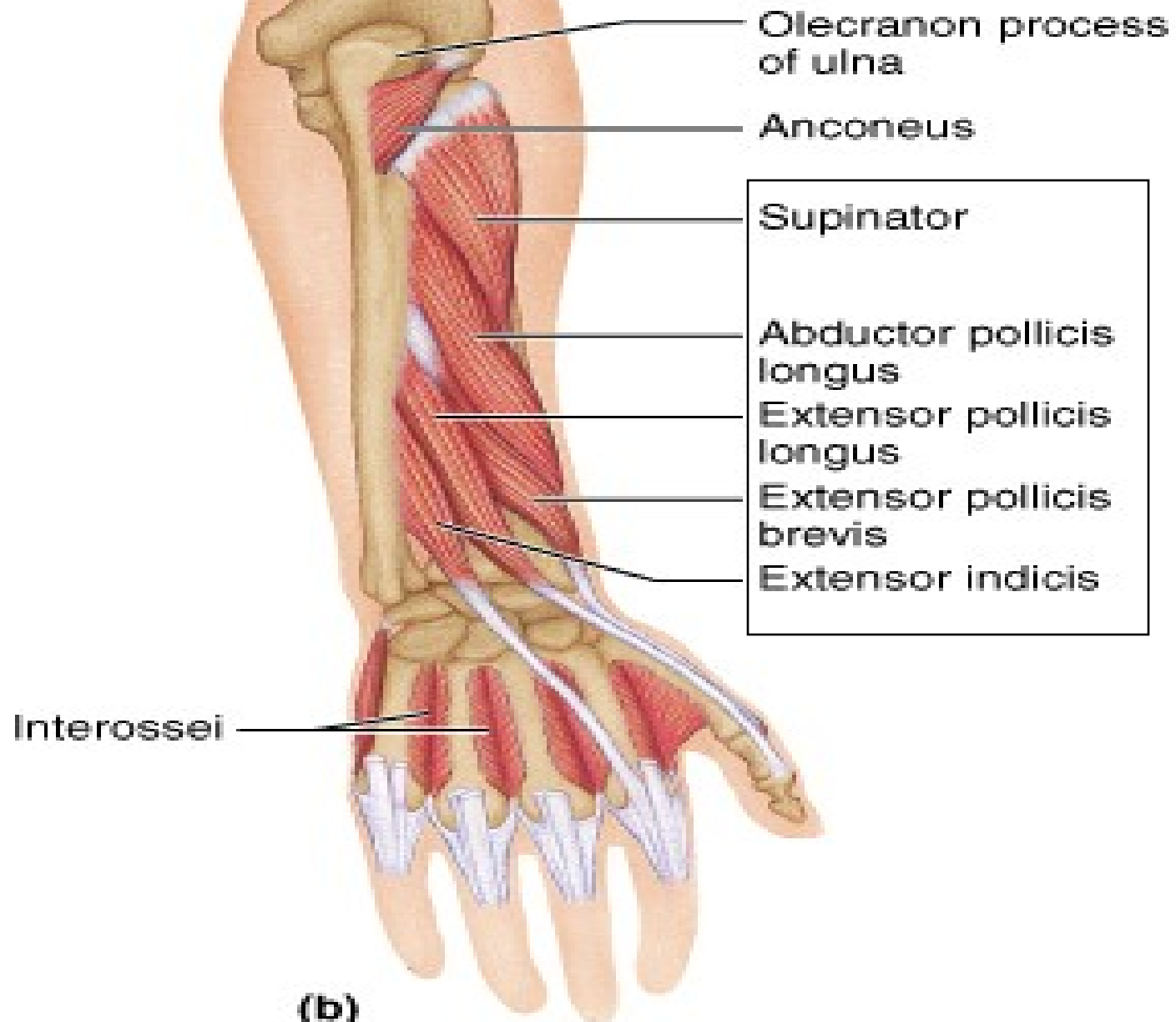


**Extensor indicis**

E

# Lt. Post. Forearm, Deep m.







**Rt. Forearm, Post.**  
**Superficial, Deep**

Brachioradialis

Insertion of  
triceps brachii

Anconeus

Flexor carpi ulnaris

Extensor carpi  
ulnaris

Extensor digit minimi

Extensor indicis

Tendons of extensor  
carpi radialis brevis  
and longus

Extensor carpi  
radialis longus

Extensor carpi  
radialis brevis

Extensor digitorum

Abductor  
pollicis longus

Extensor pollicis  
brevis

Extensor pollicis  
longus

Tendons of  
extensor  
digitorum

Extensor expansion

(a)

# Pronation Vs. Supination

- **Pronator teres & pronator quadratus** – produce one of the most important forearm movements – **Pronation**
  - Anterior, superficial & deep
  - Median n.
- **Supinator** - assist the **biceps brachii** in supinating the forearm - **Supination**
  - Posterior, deep
  - Radial n.
  - Antagonist of pronator muscles

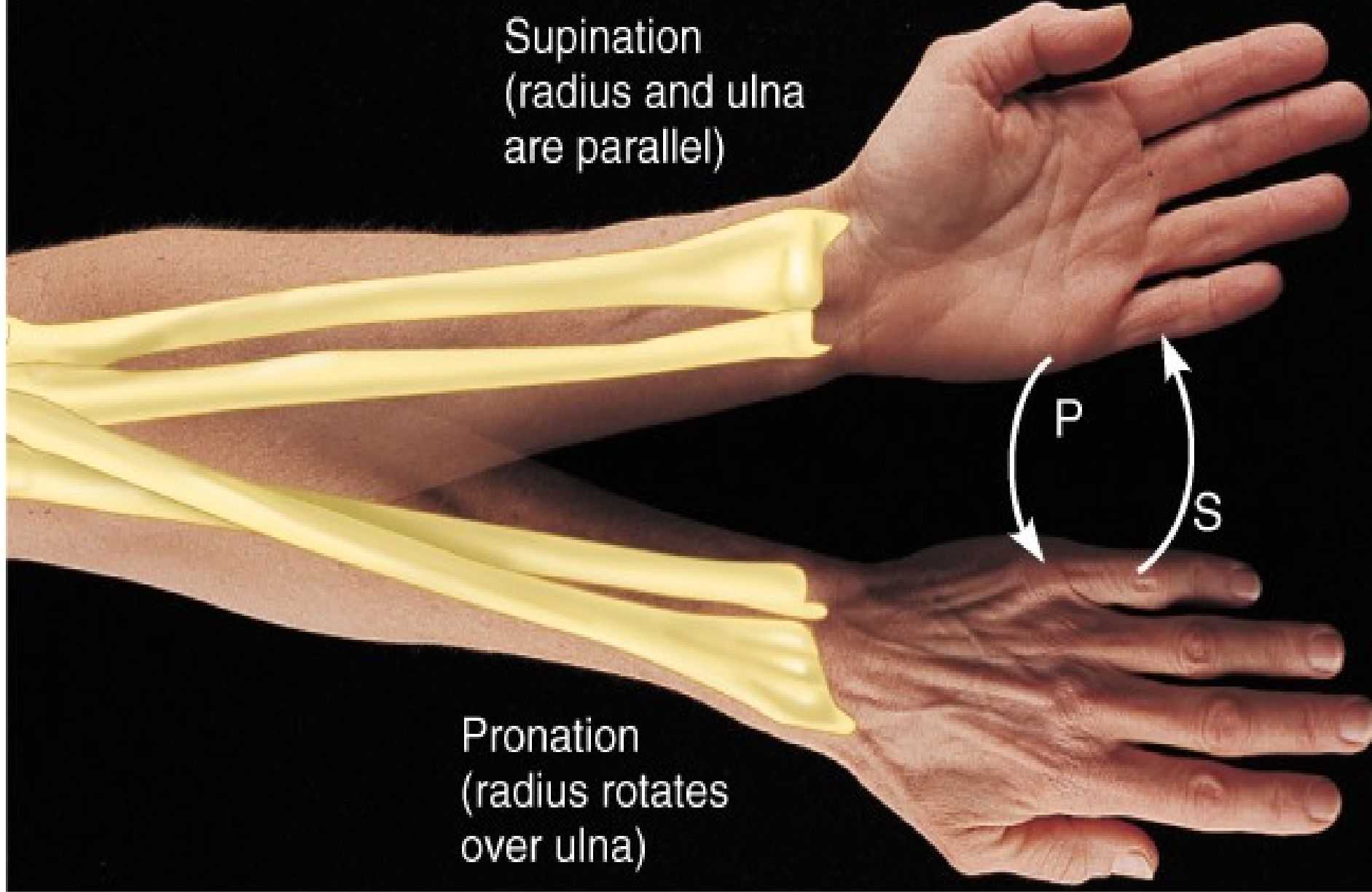
Supination  
(radius and ulna  
are parallel)

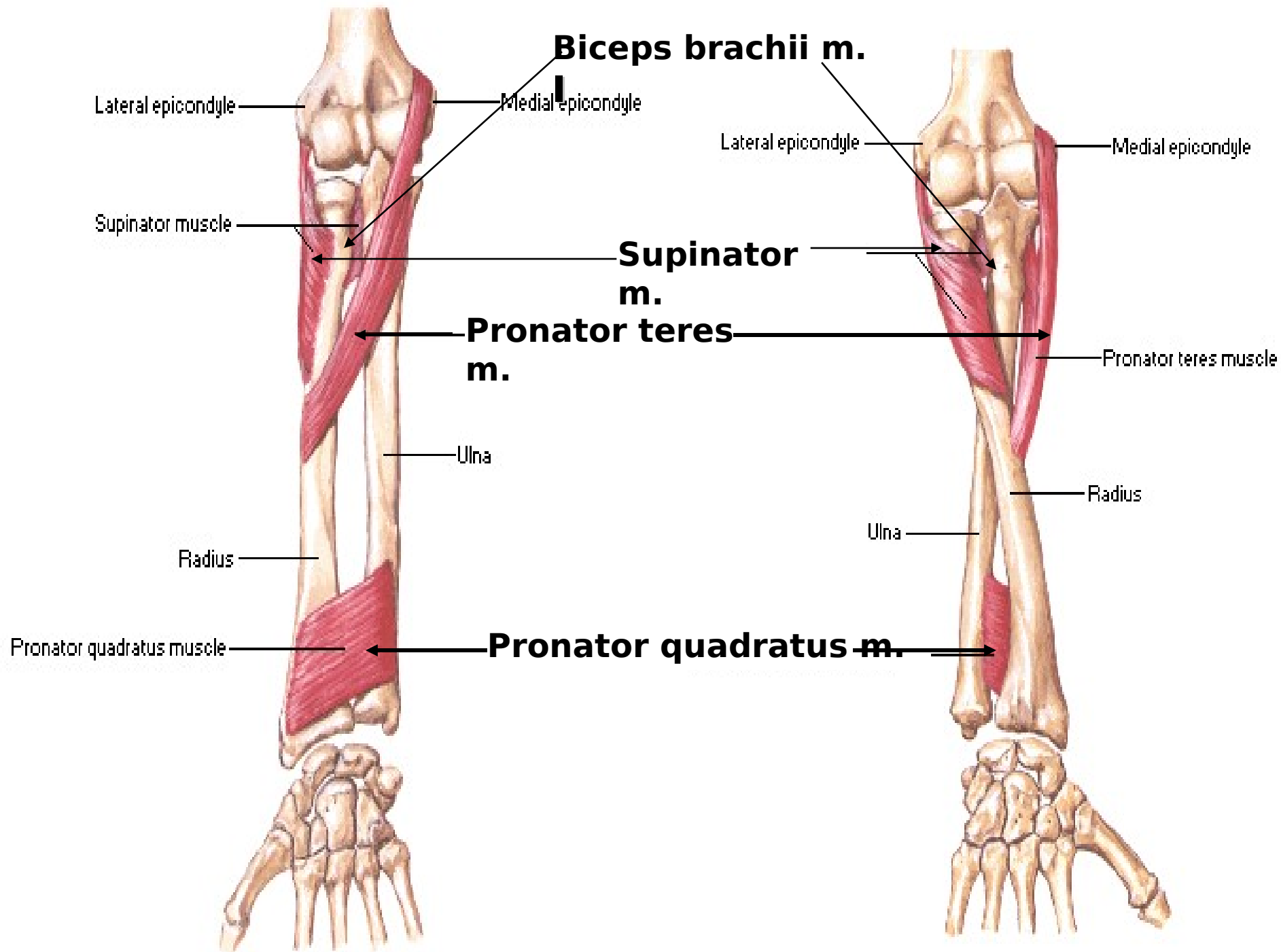
Pronation  
(radius rotates  
over ulna)

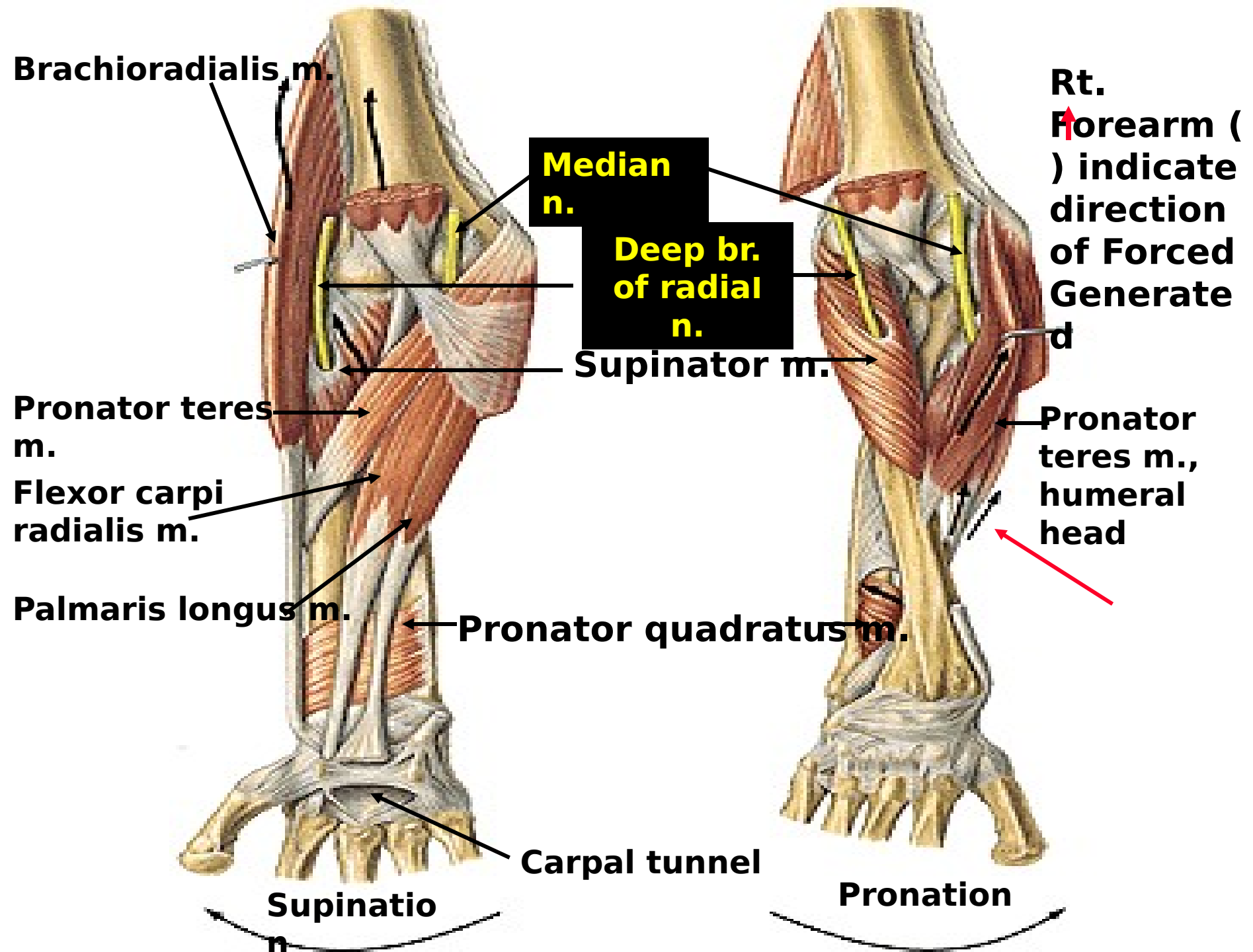
P

S

(a) Supination (S) and pronation (P)





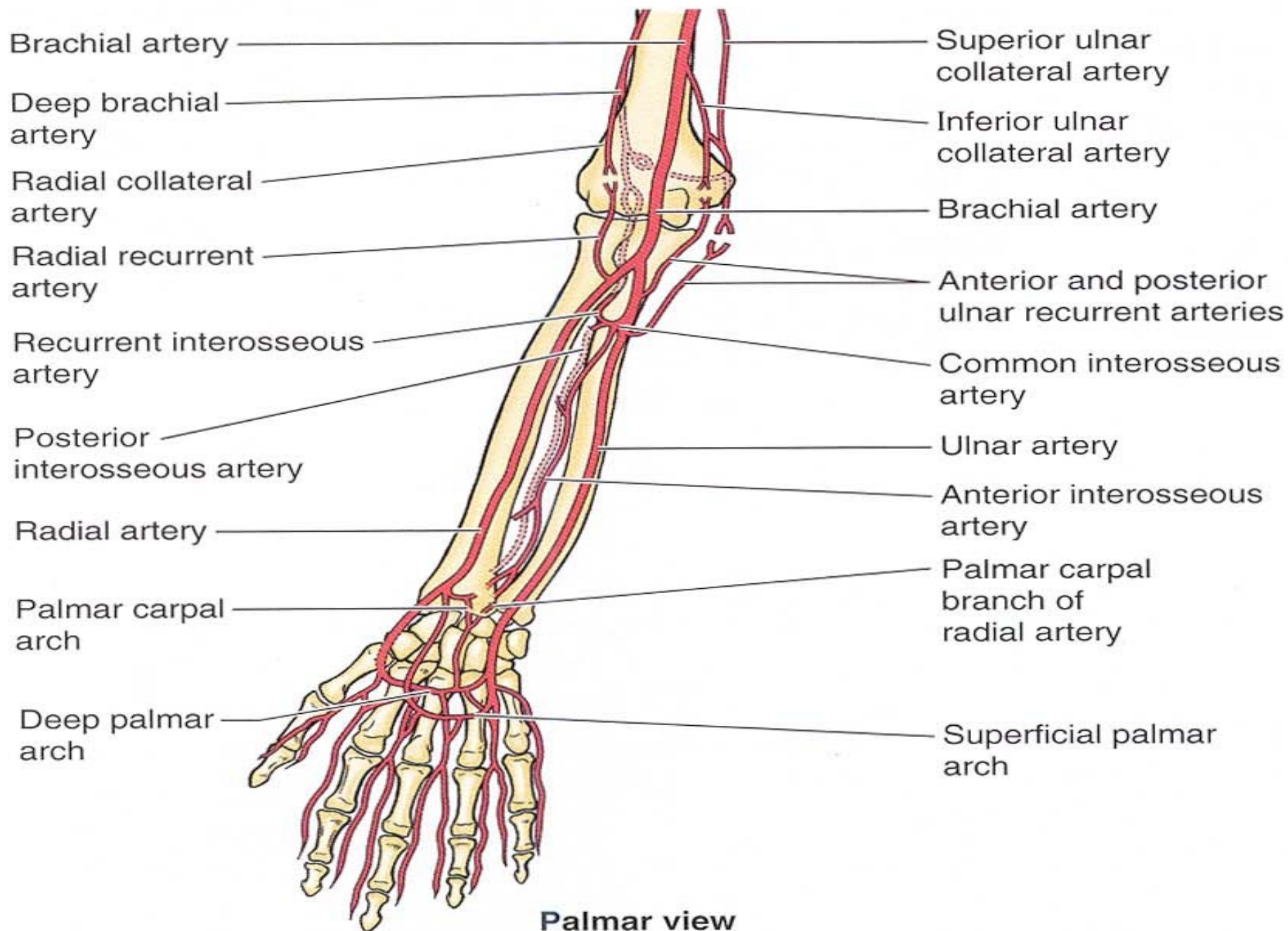


# Arteries of The Forearm

- Radial artery
  - **Radial pulse**
    - Between Flexor carpi radialis & Abductor pollicis longus tendons
- Ulnar artery
  - Common interosseus artery

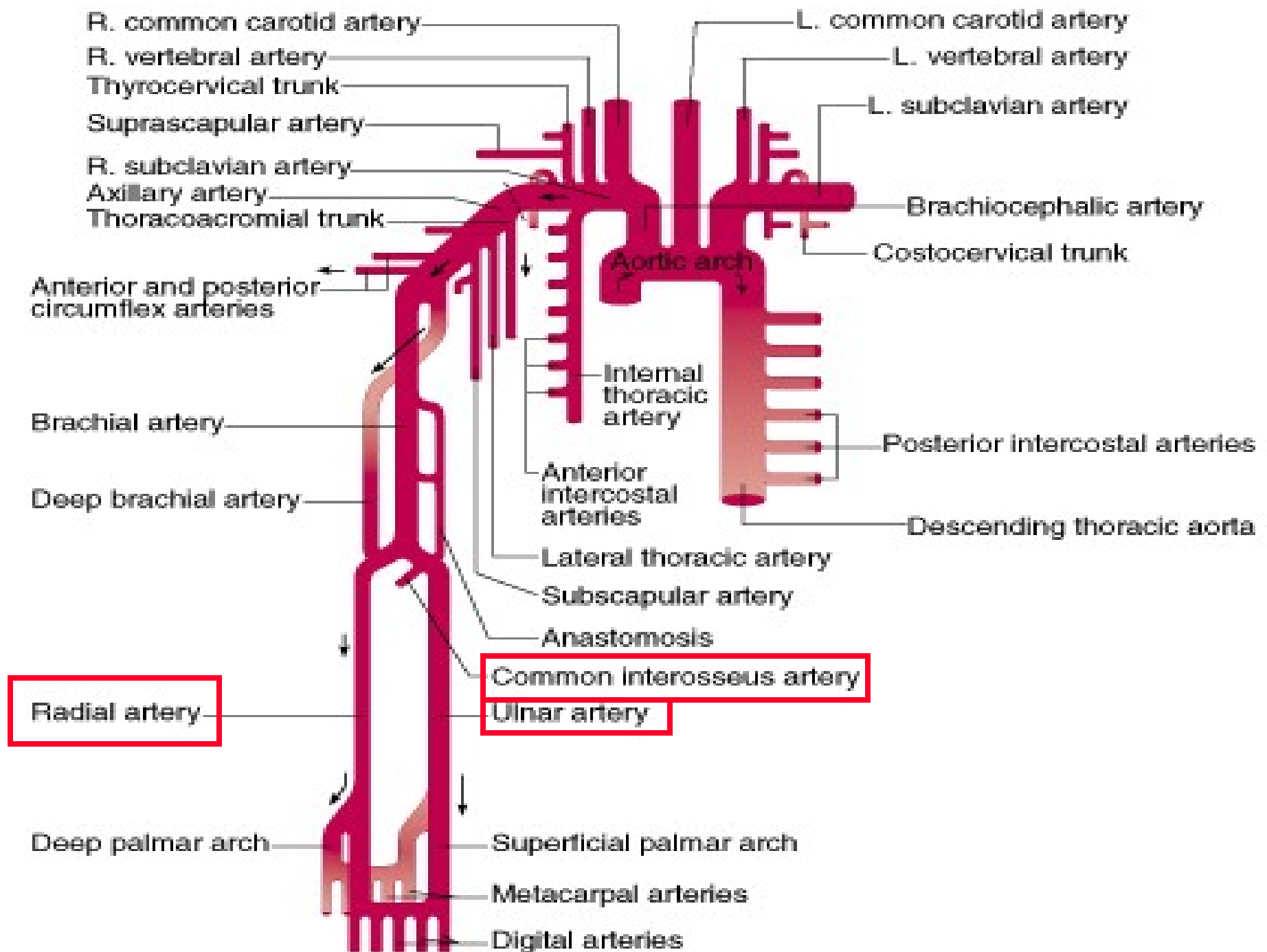


**Table 6.8. Arteries of the Forearm and Hand**

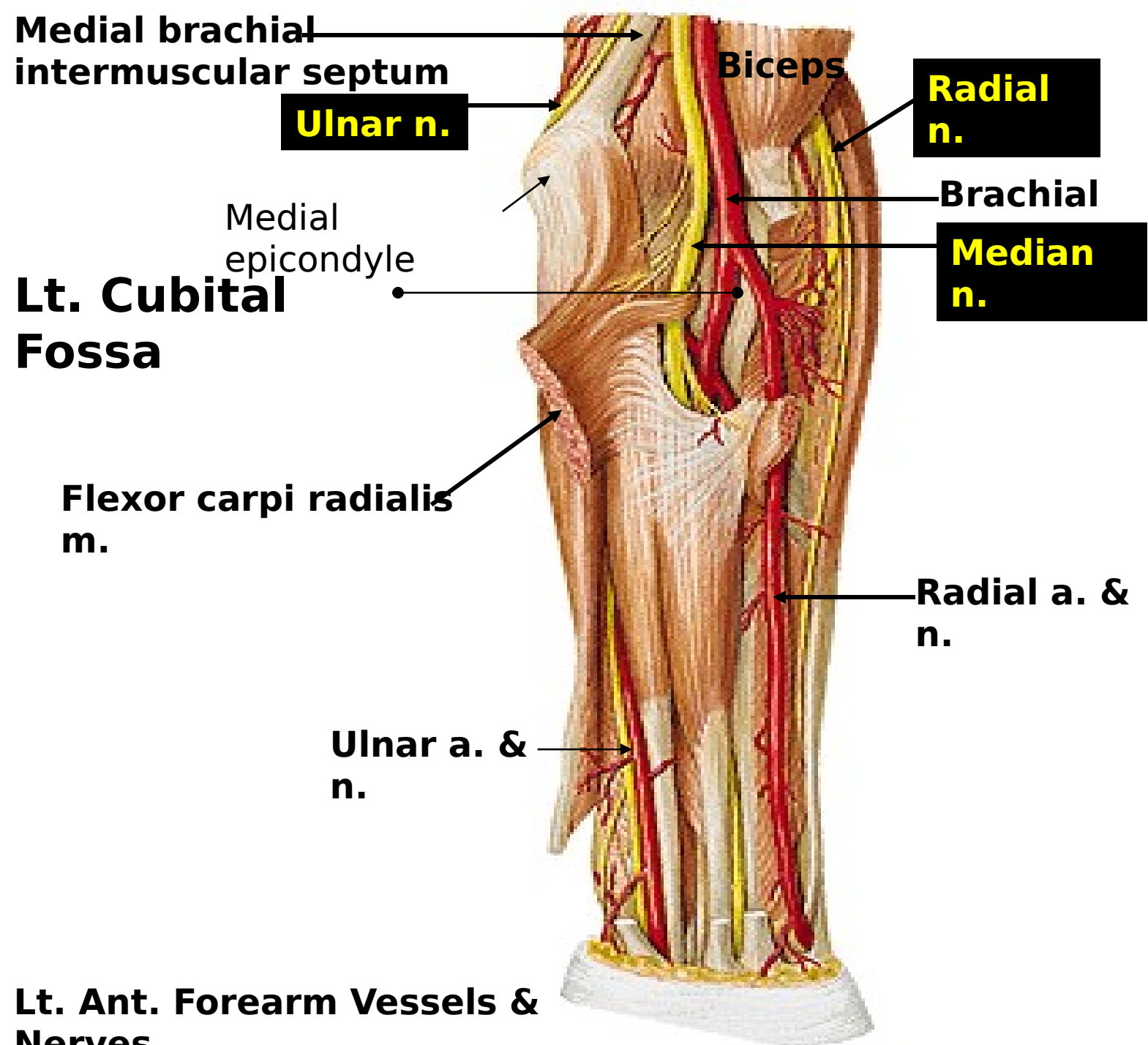




Artery	Course	Distribution
Ulnar	Larger terminal branch of brachial artery in cubital fossa	Passes inferomedially and then directly inferiorly, deep to pronator teres, palmaris longus, and flexor digitorum superficialis to reach medial side of forearm; passes superficial to flexor retinaculum at wrist and gives a deep palmar branch to deep arch and continues as superficial palmar arch
Anterior and posterior ulnar recurrent	Ulnar artery, just distal to elbow joint	Anterior ulnar recurrent artery passes superiorly and posterior ulnar collateral artery passes posteriorly to anastomose with ulnar collateral and interosseous recurrent arteries
Common interosseous	Ulnar artery, just distal to bifurcation of brachial artery	After a short course, terminates by dividing into anterior and posterior interosseous arteries
Anterior and posterior interosseous	Common interosseous artery	Pass to anterior and posterior sides of interosseous membrane: anterior interosseous artery supplies both anterior and posterior compartments in distal forearm; the posterior interosseous artery gives off the recurrent interosseous artery, which participates in the arterial anastomoses around the elbow
Dorsal and palmar carpal branches	Ulnar artery at level of wrist	Anastomose with corresponding branches of radial artery to form dorsal and palmar carpal arches, providing collateral circulation at wrist
Radial	Smaller terminal division of brachial artery in cubital fossa	Runs inferolaterally under cover of brachioradialis and distally lies lateral to flexor carpi radialis tendon; winds around lateral aspect of radius and crosses floor of anatomical snuff box to pierce fascia; ends by forming deep palmar arch with deep branch of ulnar artery
Radial recurrent	Lateral side of radial artery, just distal to its origin	Ascends on supinator and then passes between brachioradialis and brachialis
Dorsal and palmar carpal branches	Radial artery at level of wrist	Anastomose with corresponding branches of ulnar artery to form dorsal and palmar carpal arches, providing collateral circulation at wrist







Vertebral artery

Thyrocervical trunk

Costocervical trunk

Suprascapular artery

Thoracoacromial trunk

Axillary artery

Subscapular artery

Posterior circumflex

humeral artery

Anterior circumflex

humeral artery

Brachial artery

Deep brachial

artery

Common interosseous  
artery

Radial artery

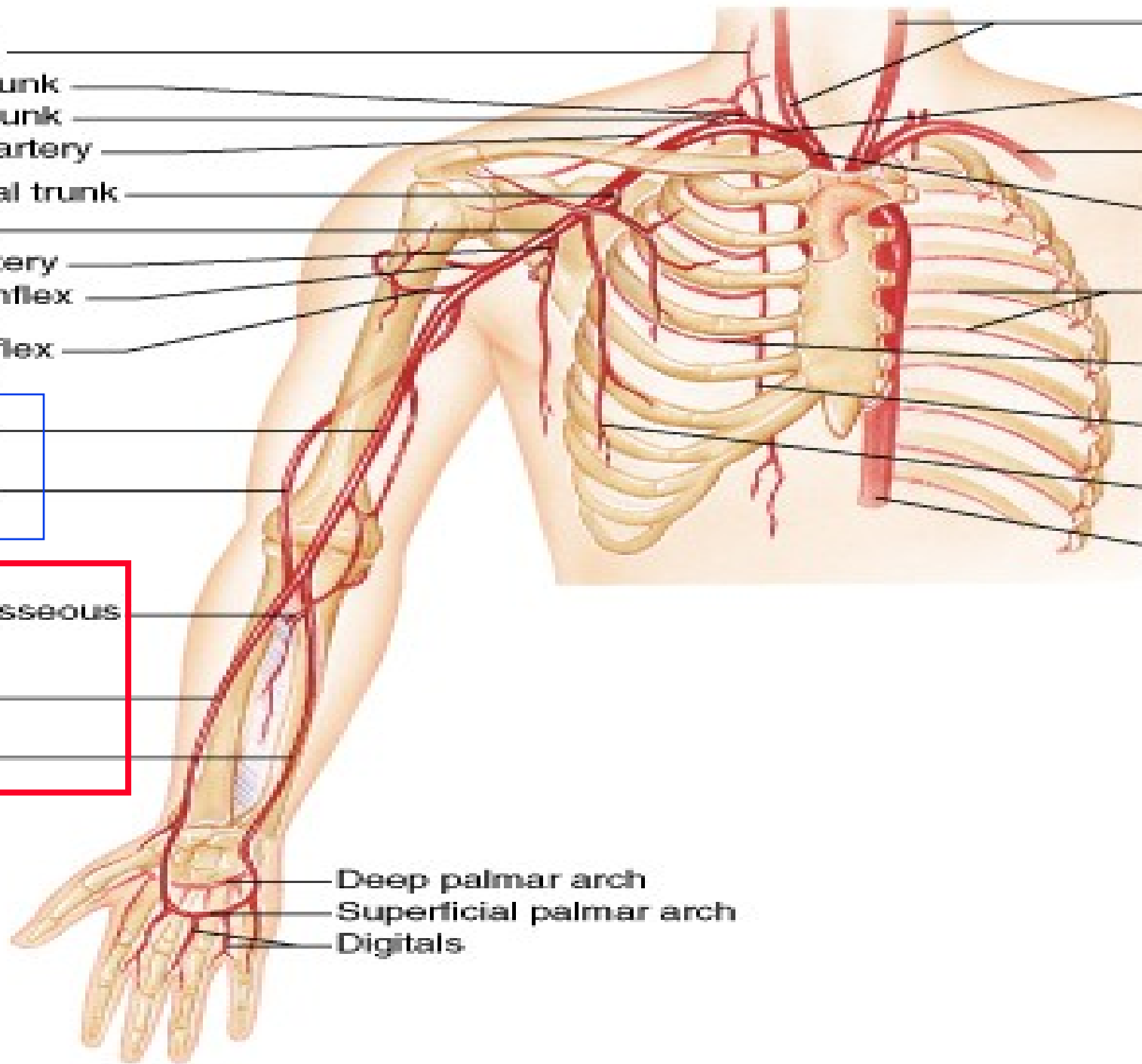
Ulnar artery

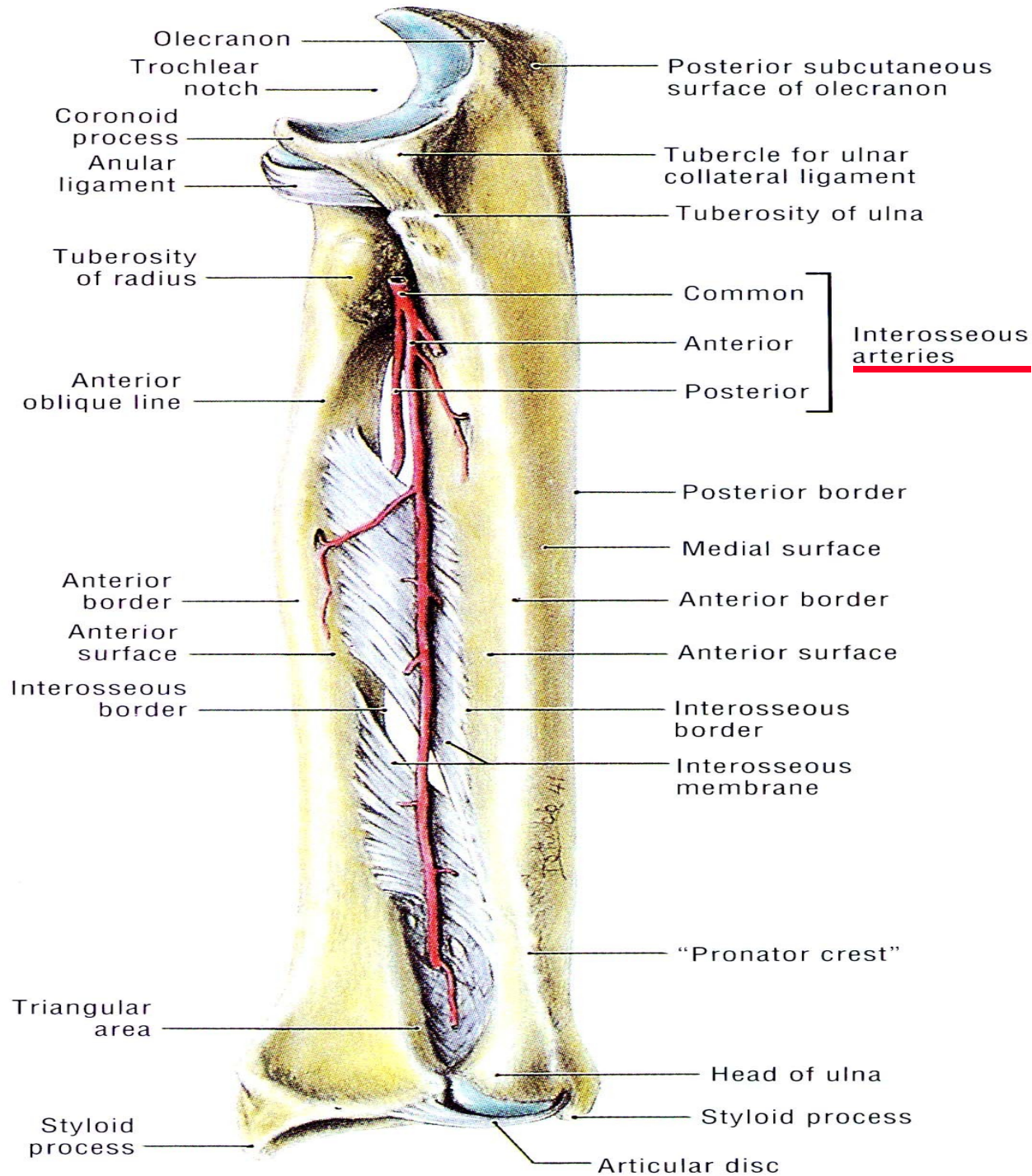
Deep palmar arch

Superficial palmar arch

Digitals

(b)

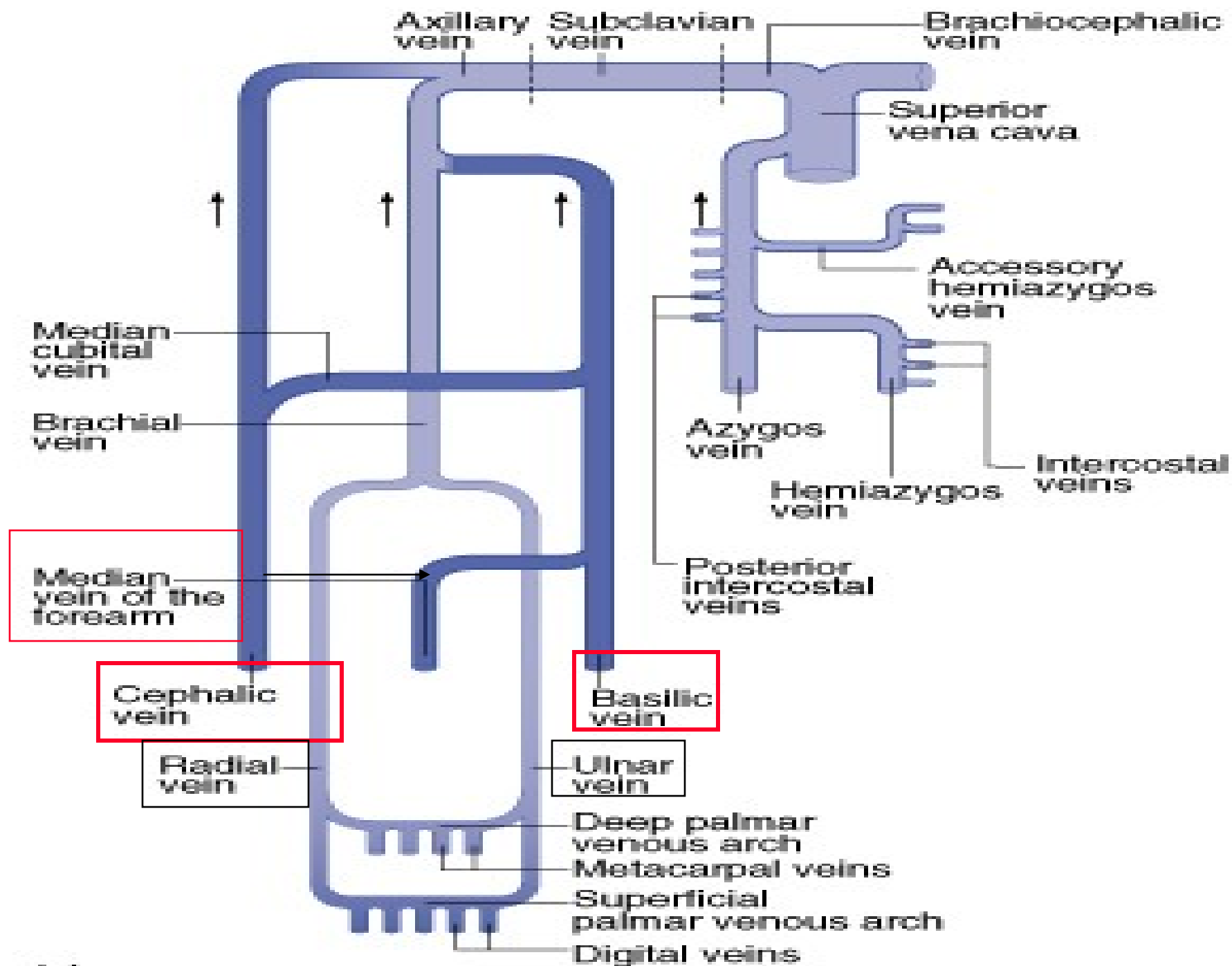






# Veins of The Forearm

- Superficial Veins
  - Cephalic vein
  - Basilic vein
    - Median vein of the forearm
- Deep Veins
  - Radial vein
  - Ulnar vein



Axillary vein

Brachial vein

Cephalic vein

Basilic vein

Median cubital vein

Median vein  
of the forearm

Cephalic vein

Radial vein

Basilic vein

Ulnar vein

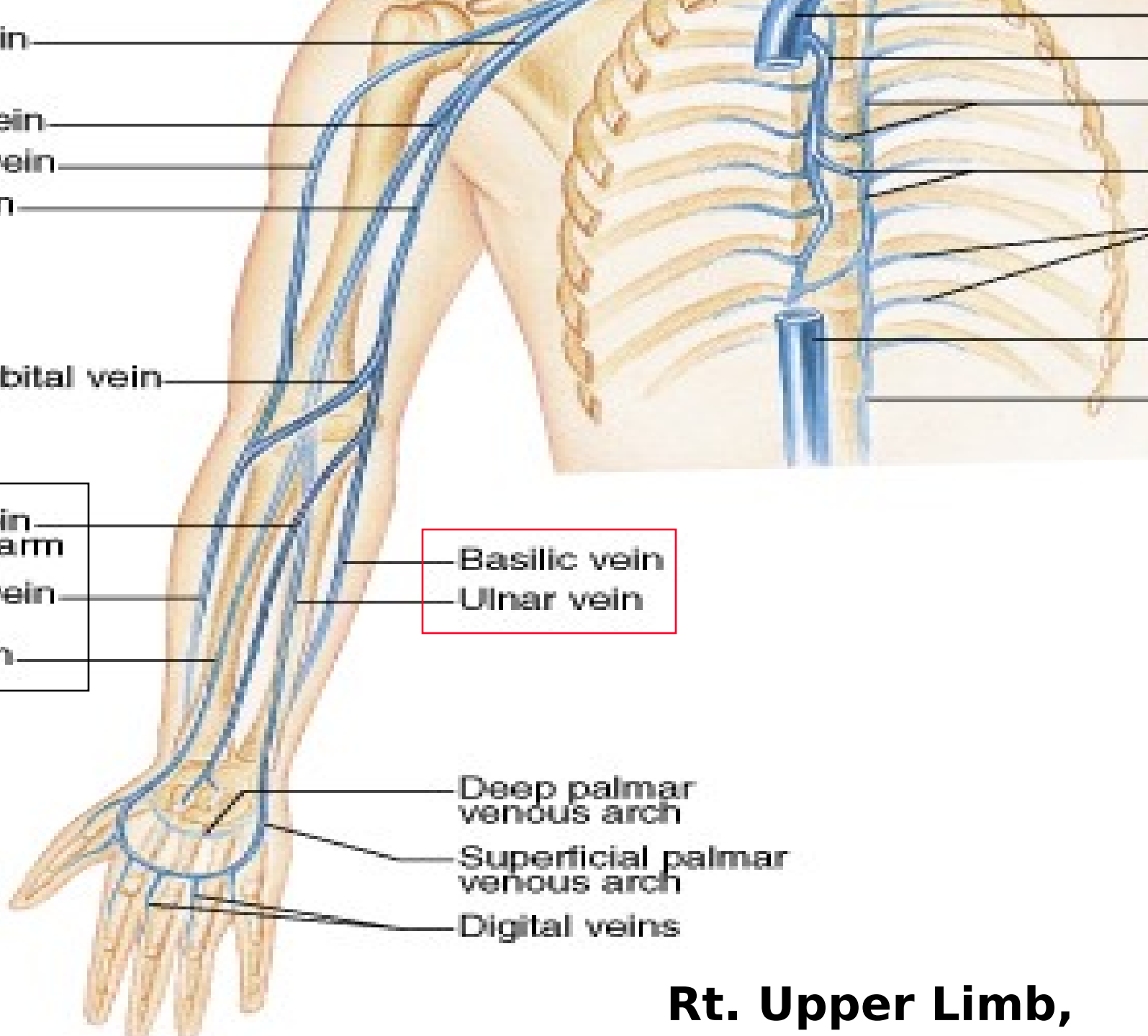
Deep palmar  
venous arch

Superficial palmar  
venous arch

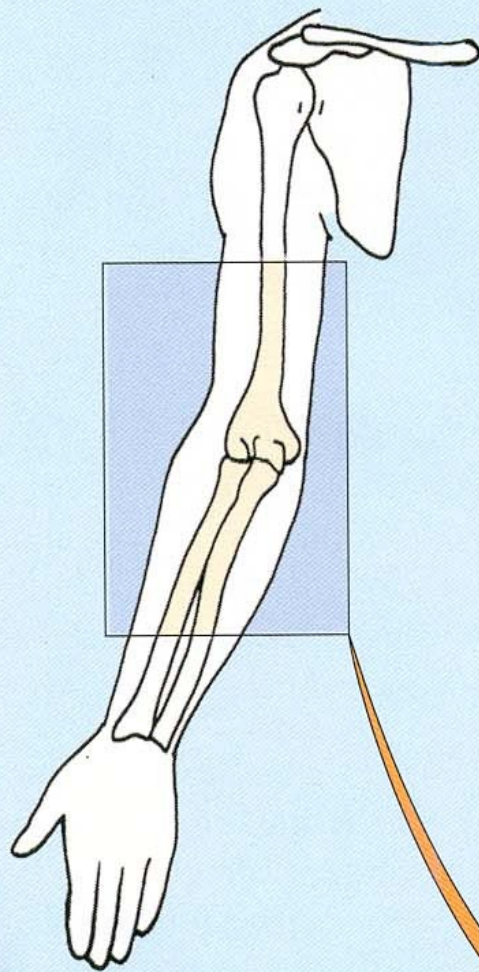
Digital veins

(b)

**Rt. Upper Limb,**







Cephalic vein

Radial artery

Deep fascia of arm

Basilic vein

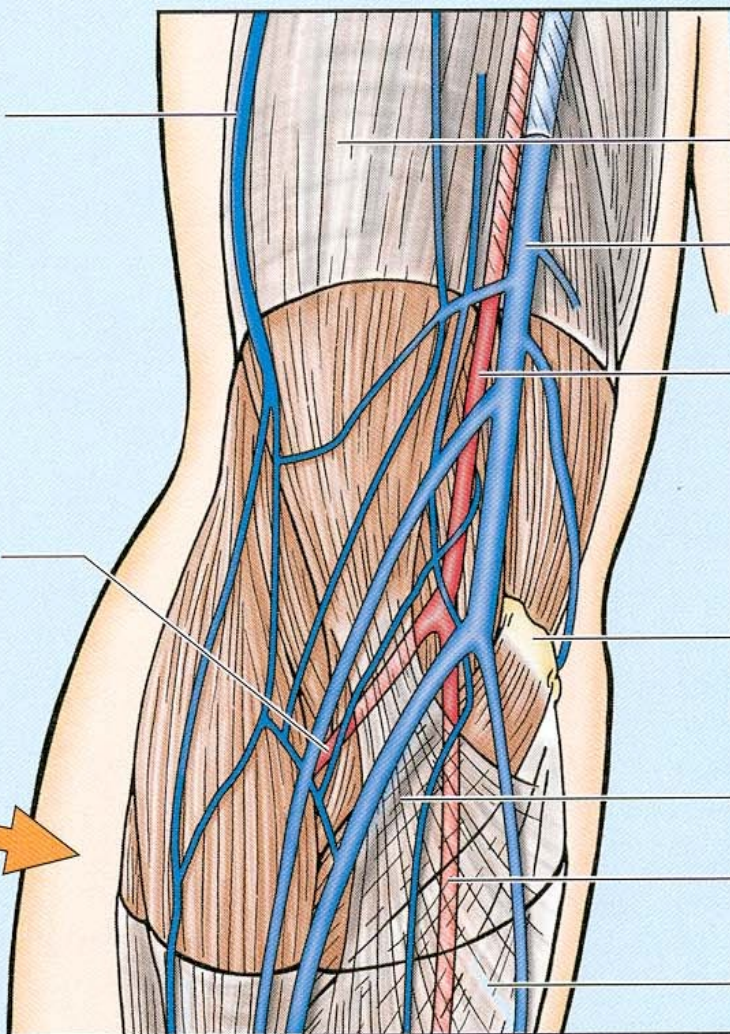
Brachial artery

Medial epicondyle

Bicipital aponeurosis

Superficial ulnar artery

Deep fascia of forearm





Deltopectoral lymph nodes

Deltoid

Cephalic vein

Median cubital vein

Cephalic vein

Pectoralis major (clavicular head; reflected)

Axillary vein

Deltopectoral triangle

Pectoralis major (sternal head)

To axillary lymph nodes

Basilic vein

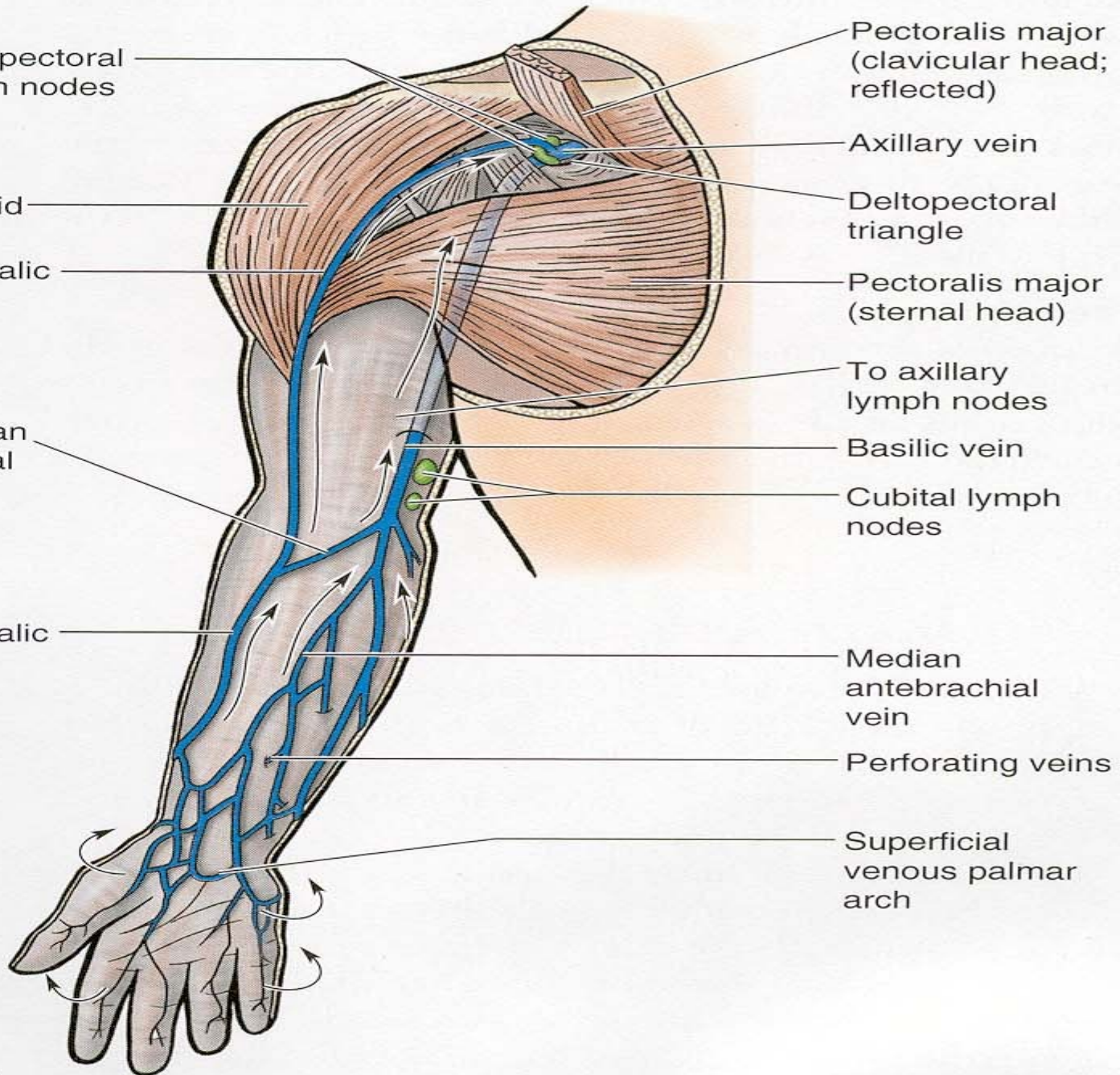
Cubital lymph nodes

Median antebrachial vein

Perforating veins

Superficial venous palmar arch

(B) Anterior view



**Cephalic  
v.**

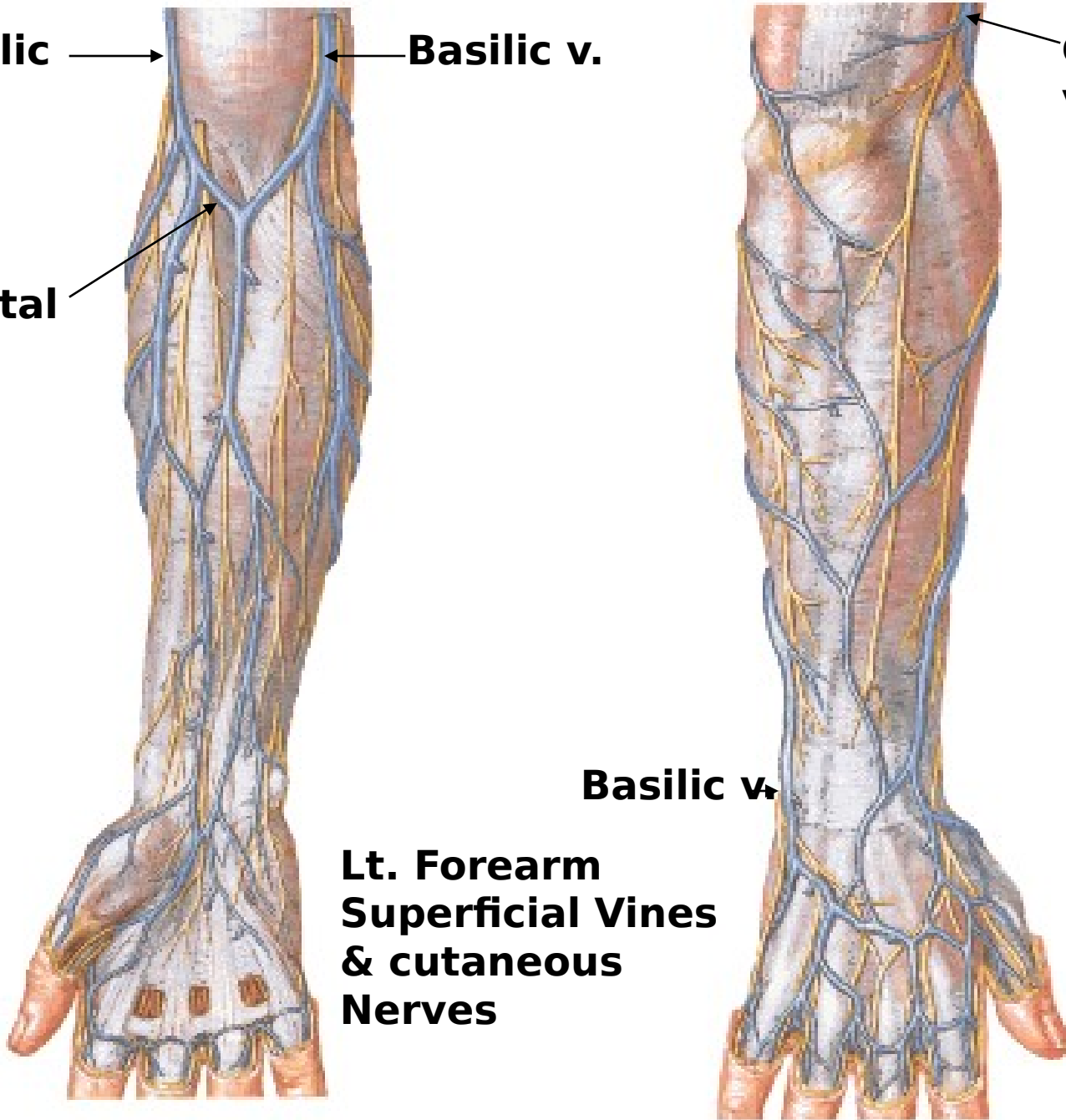
**Basilic v.**

**Median cubital  
v.**

**Cephalic  
v.**

**Basilic v.**

**Lt. Forearm  
Superficial Vines  
& cutaneous  
Nerves**





# Innervation Of The Forearm

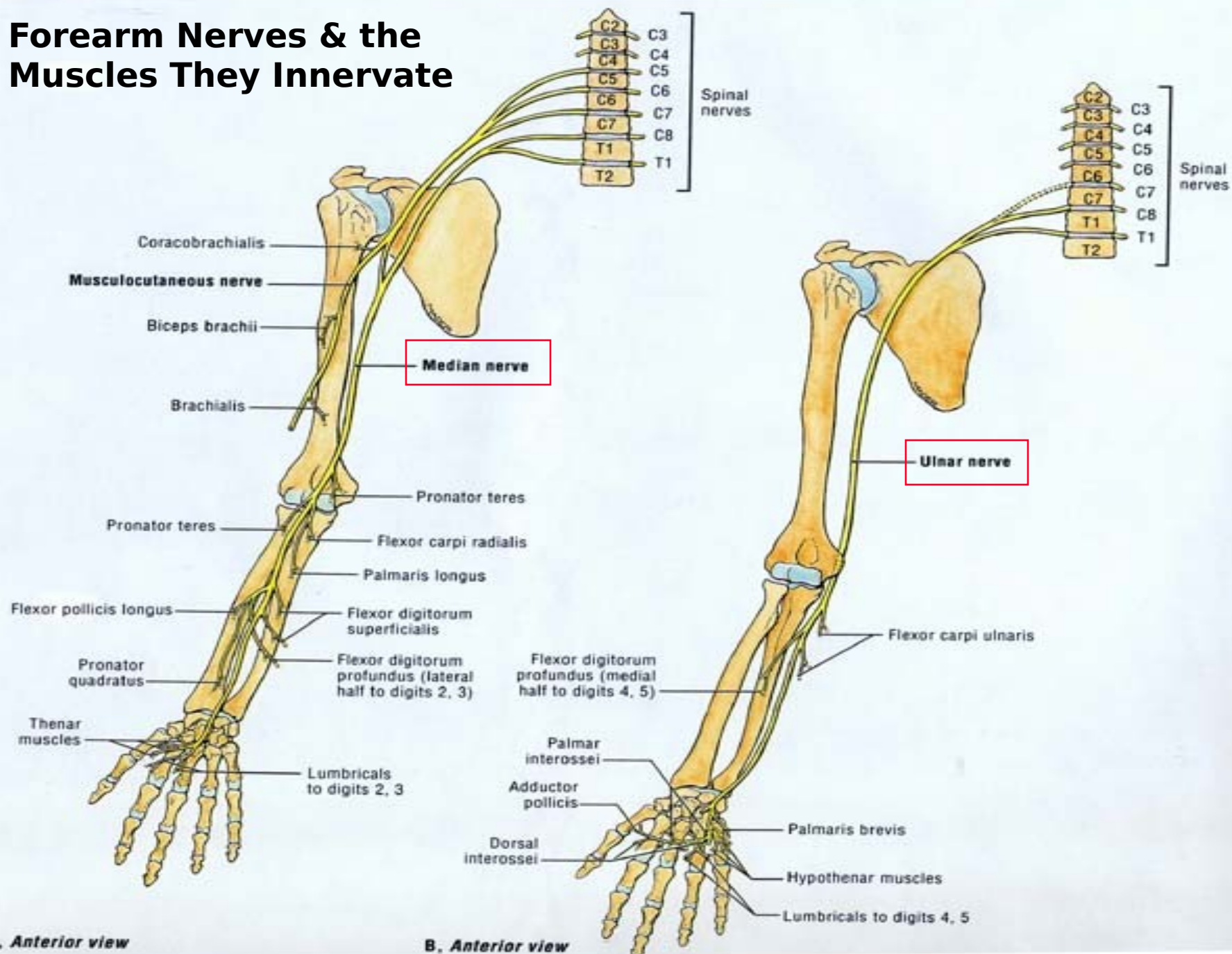
- Ulnar n.
- Radial n.
  - Deep branch
  - Superficial branch
- Interosseous n.
  - Anterior branch
  - Posterior branch
- Median n.
- Musculocutaneous n.

Major terminal branches (peripheral nerves)	Cords	Divisions	Trunks	Roots (ventral rami)
<div> <div> Musculocutaneous Median Ulnar Radial Axillary </div> <div> Lateral Medial Posterior </div> <div> Anterior Posterior Anterior Posterior Anterior Posterior </div> <div> Upper Middle Lower </div> <div> C<sub>5</sub> C<sub>6</sub> C<sub>7</sub> C<sub>8</sub> T<sub>1</sub> </div> </div>				

Nerve	Origin	Course
<u>Median</u>	By two roots from lateral (C6 and C7) and medial (C8 and T1) cords of brachial plexus	Enters cubital fossa medial to brachial artery, passes between heads of pronator teres, descends between flexor digitorum superficialis and flexor digitorum profundus, and passes close to flexor retinaculum as it passes through carpal tunnel to reach hand
Anterior interosseous	Median nerve in distal part of cubital fossa	Passes inferiorly on interosseous membrane to supply flexor digitorum profundus, flexor pollicis longus, and pronator quadratus
Palmar cutaneous branch of median	Median nerve just proximal to flexor retinaculum	Passes between tendons of palmaris longus and flexor carpi radialis and runs superficial to flexor retinaculum
<u>Ulnar</u>	Medial cord of brachial plexus (C8 and T1), but it often receives fibers from ventral ramus of C7	Passes posteriorly to medial epicondyle of humerus and enters forearm between heads of flexor carpi ulnaris; descends through forearm between flexor carpi ulnaris and flexor digitorum profundus; becomes superficial in distal part of forearm and passes superficial to flexor retinaculum
Palmar cutaneous branch of ulnar nerve	Ulnar nerve near middle of forearm	Descends on ulnar artery and perforates deep fascia in the distal third of forearm
<u>Radial</u>	Posterior cord of brachial plexus (C5–C8 and T1)	Passes into cubital fossa and descends between brachialis and brachioradialis; at level of lateral epicondyle of humerus, it divides into superficial and deep branches
Superficial branch of radial nerve	Continuation of radial nerve after deep branch is given off	Passes distally, anterior to pronator teres and deep to brachioradialis; pierces deep fascia at wrist and passes onto dorsum of hand
Deep branch of radial nerve	Arises from radial nerve just distal to elbow	Winds around neck of radius in supinator; enters posterior compartment to supply muscles shown in diagram
Posterior interosseous	Terminal branch of deep branch of radial nerve	Passes deep to extensor pollicis longus and ends on interosseous membrane



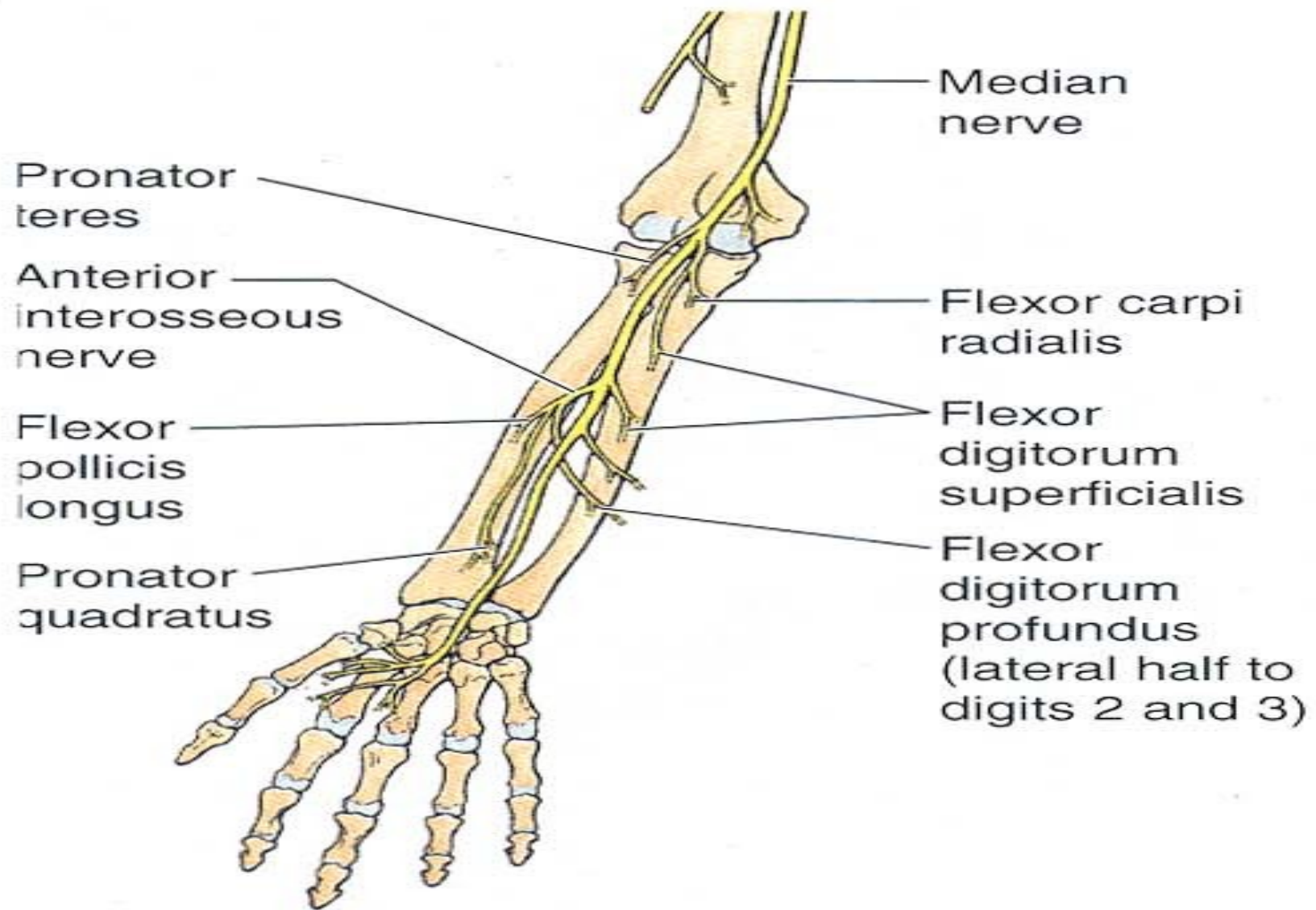
# Forearm Nerves & the Muscles They Innervate



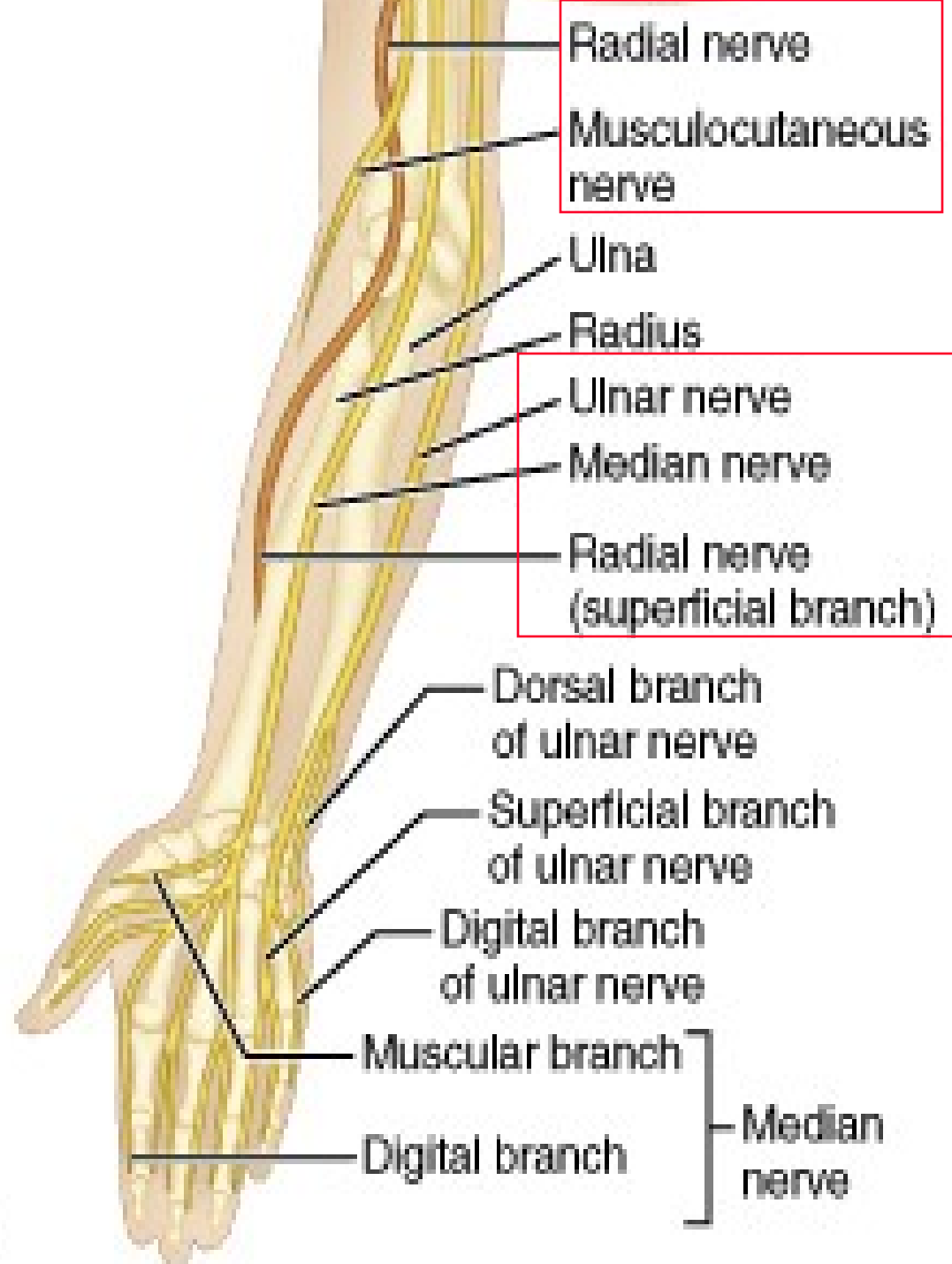
A. Anterior view

B. Anterior view

**Table 6.9. Nerves of the Forearm**



**Median nerve  
Anterior view**



(c)



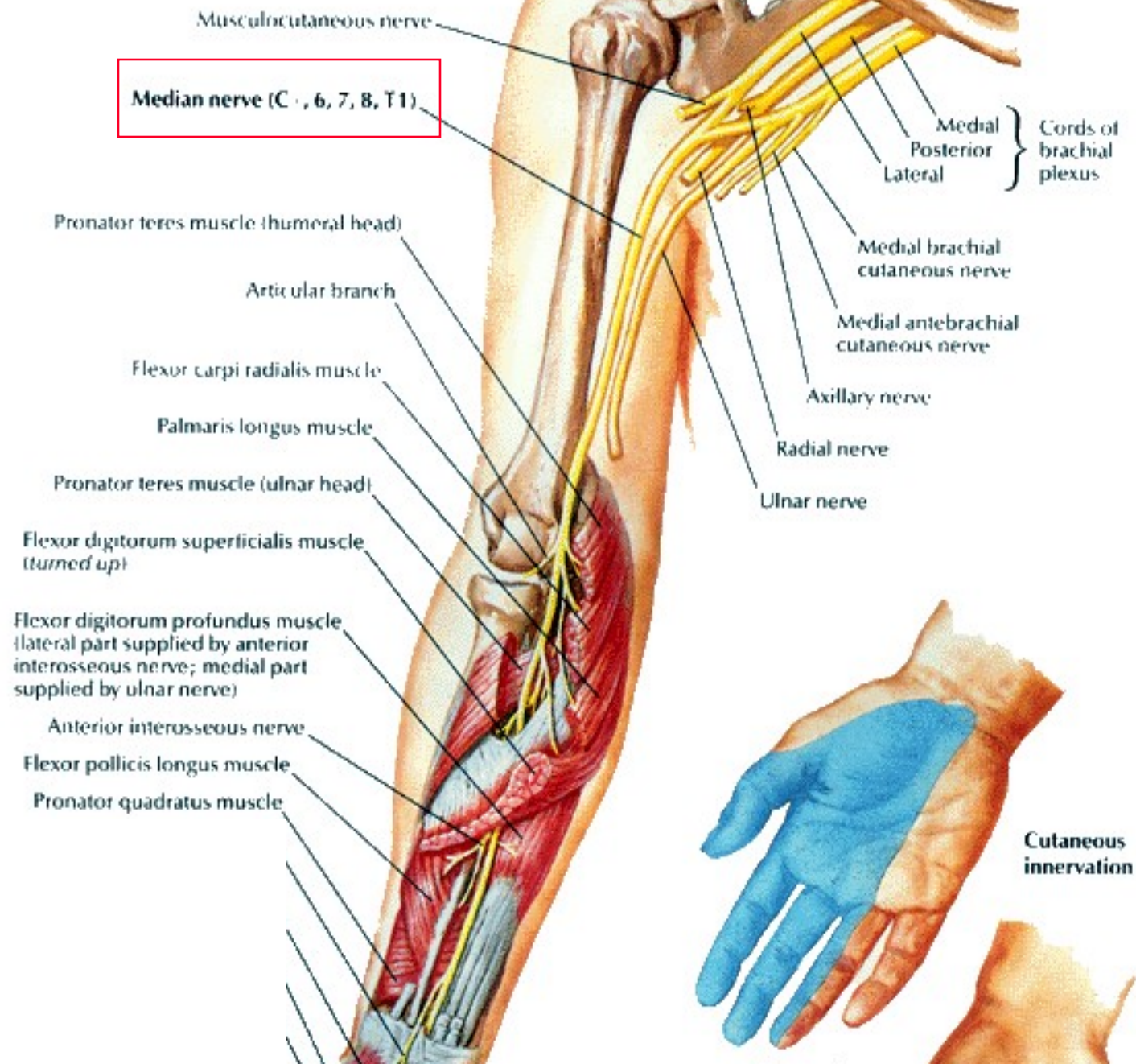
# NERVE SUPPLY TO FOREARM MUSCLES

# Nerve Supply To Forearm Muscles

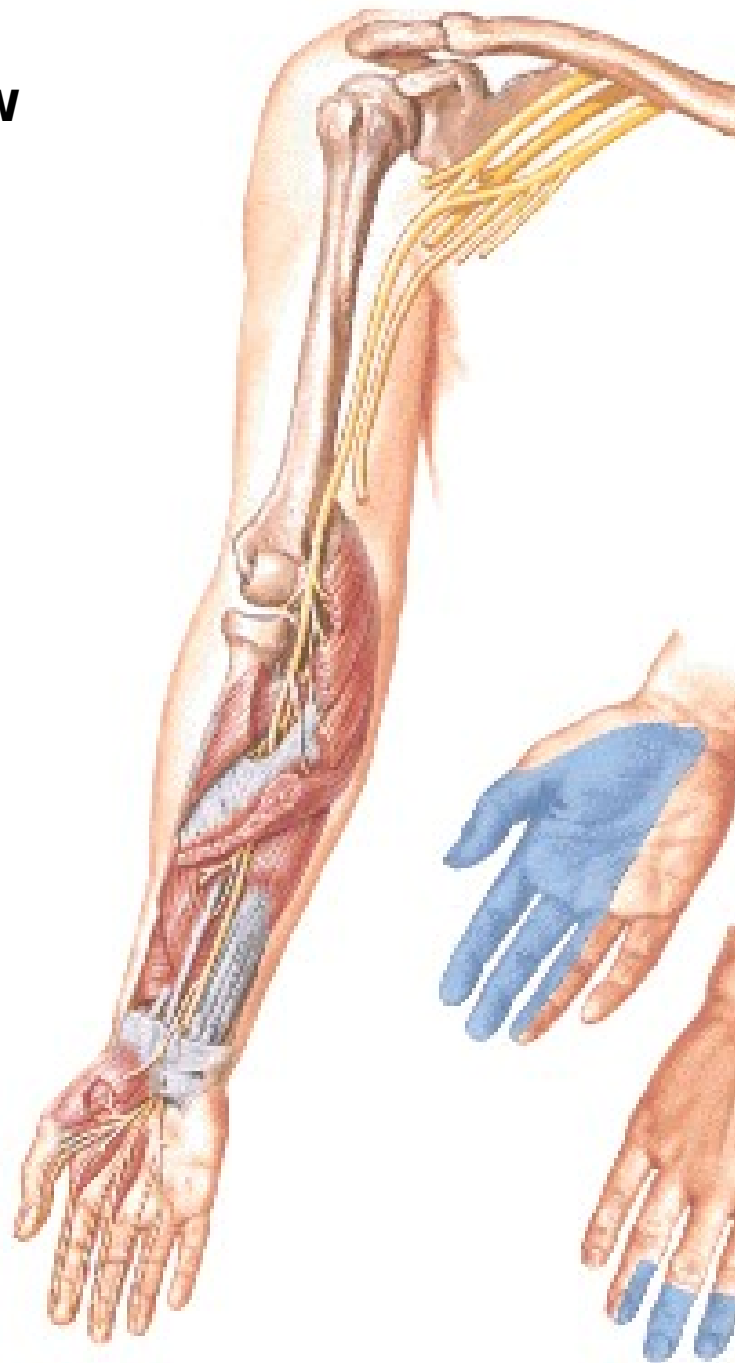
- Median nerve (Anterior muscles)
  - Pronator teres
  - Flexor carpi radialis
  - Palmaris longus
  - Flexor digitorum superficialis
  - Flexor pollicis longus
  - Pronator quadratus
  - 1/2 of Flexor digitorum profundus

## Anterior view

Note: only muscles innervated by median nerve shown



## **ANTERIOR VIEW**



**Median nerve to forearm m  
and thenar mm of hand**

**Cutaneous innervation  
of the median nerve**



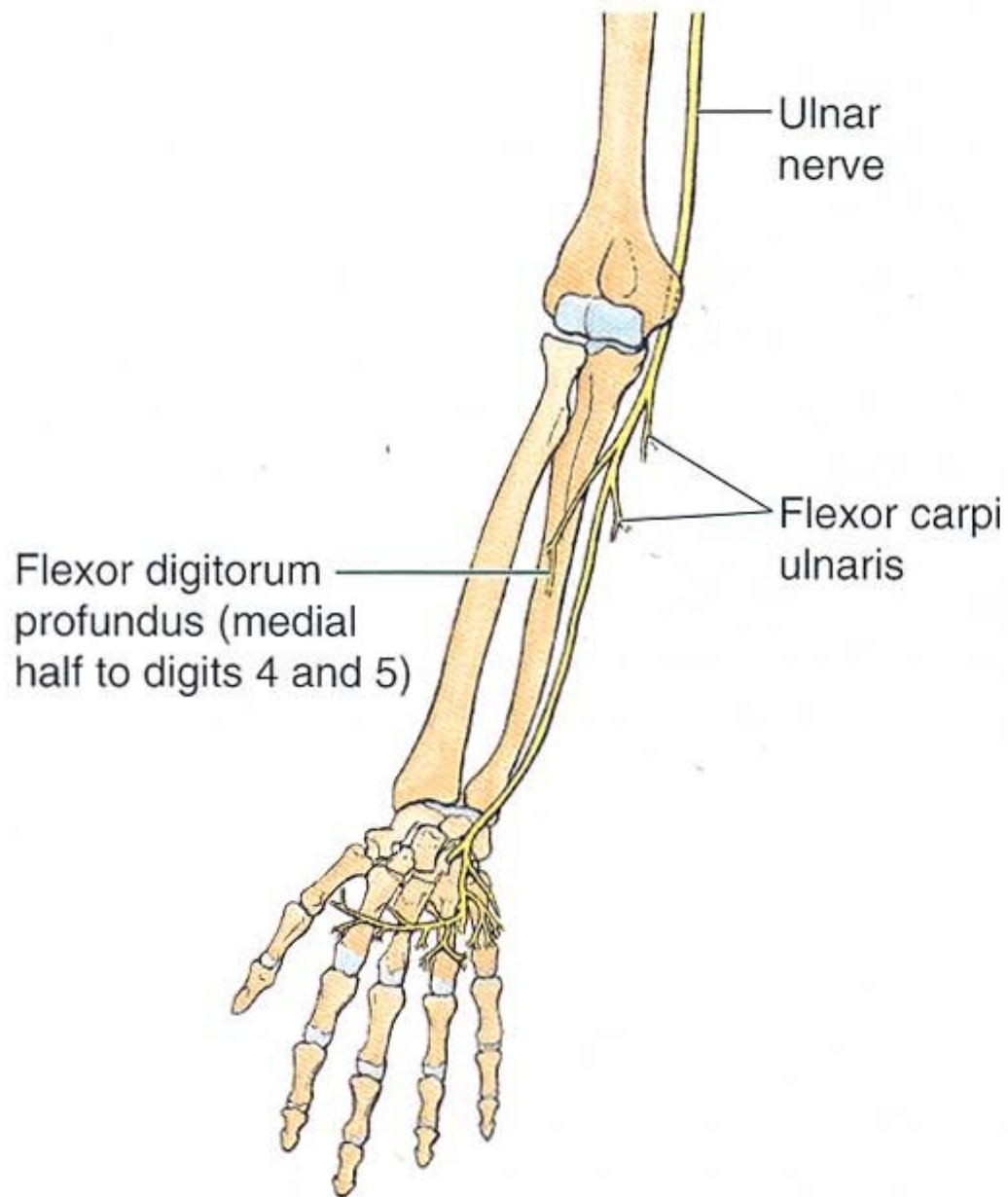
# Nerve Supply To Forearm Muscles

- Radial nerve (Posterior muscles)
  - Extensor carpi radialis longus & brevis
  - Extensor digitorum
  - Supinator

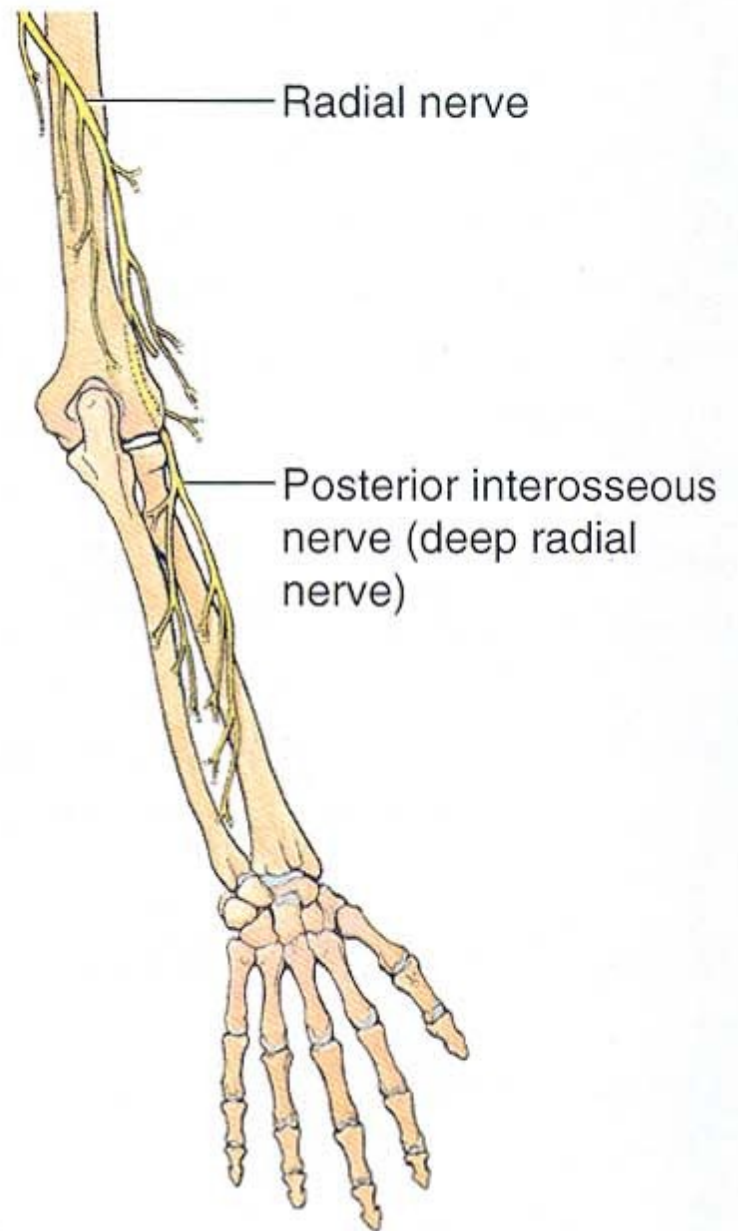
# Nerve Supply To Forearm Muscles

- Ulnar nerve
  - Flexor carpi ulnaris
  - 1/2 of Flexor digitorum profundus





**Ulnar nerve**  
**Anterior view**



**Radial nerve**  
**Posterior view**

### Anterior view

Note: only muscles innervated by ulnar nerve shown

- Ulnar nerve (C<sub>5</sub>, 8, T1)  
(no branches above elbow)

Medial epicondyle

Articular branch  
(behind condyle)

- Flexor digitorum profundus muscle (medial part only; lateral part supplied by anterior interosseous branch of median nerve)

Flexor carpi ulnaris muscle  
(drawn aside)

- Dorsal branch of ulnar nerve

—Palmar branch

### Cutaneous innervation

### Palmar view

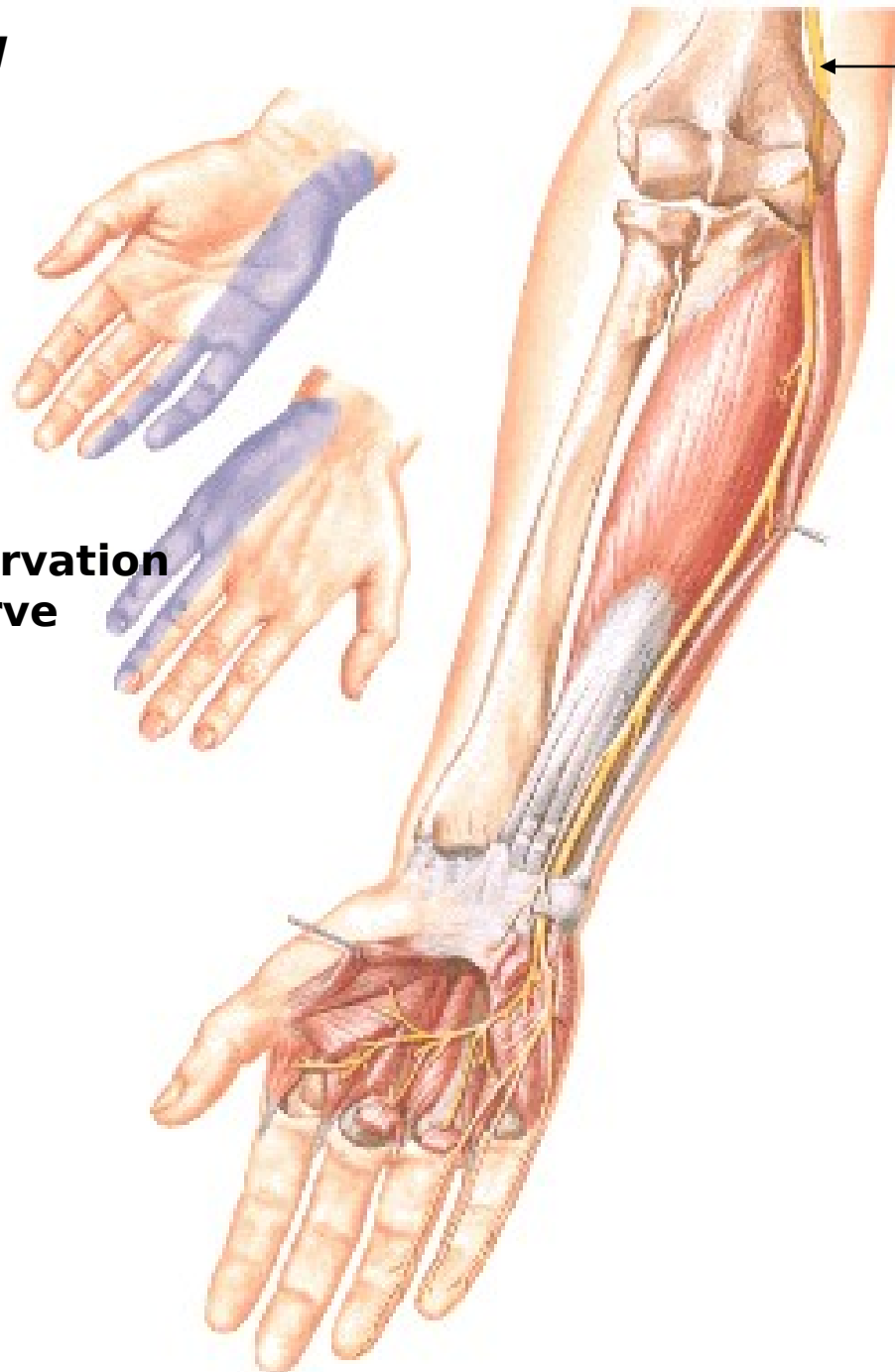
Posterior  
(dorsal) view

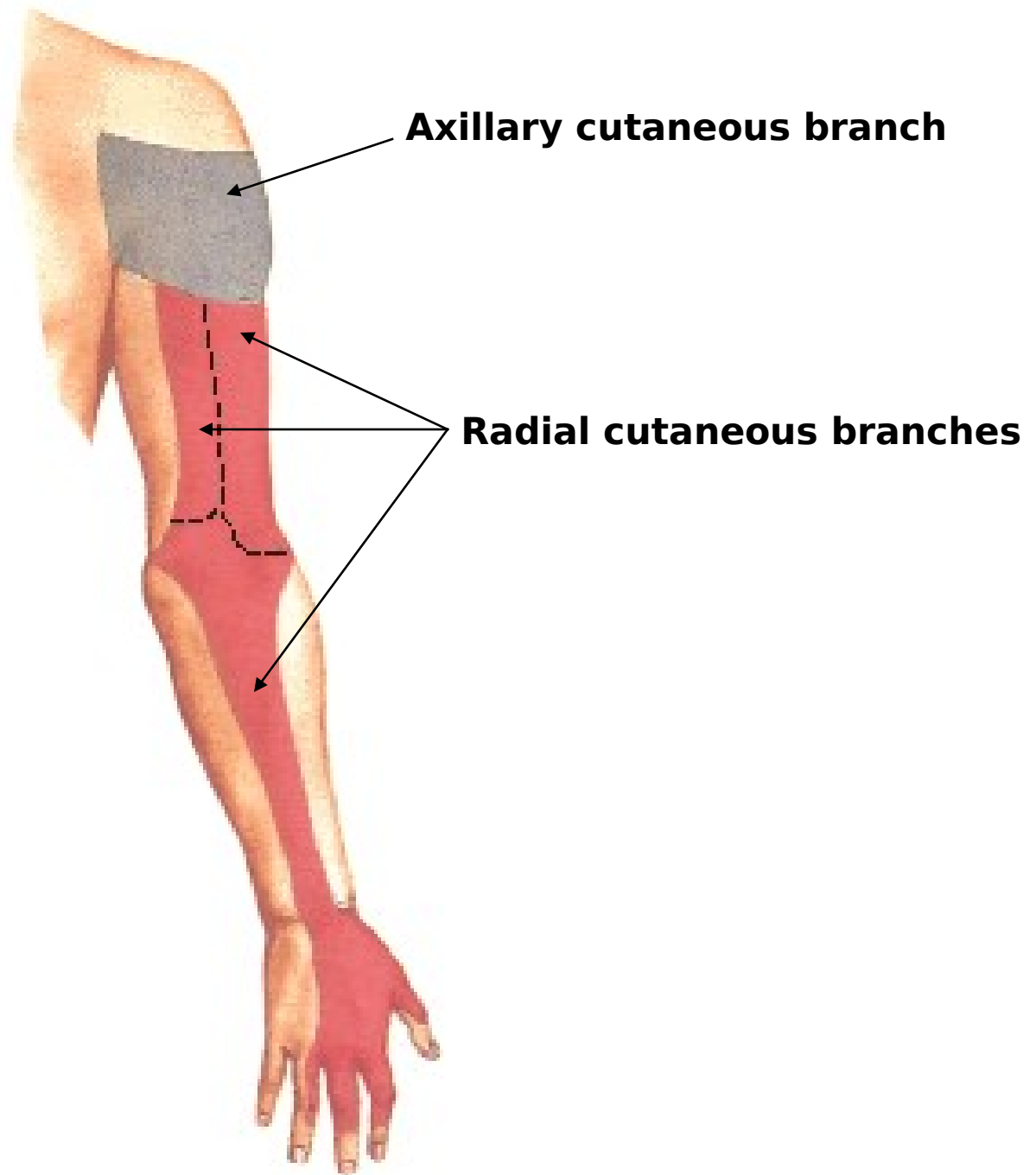
## **ANTERIOR VIEW**

**Cutaneous innervation  
of the ulnar nerve**

**Ulnar nerve**

**Forearm flexors  
associated with the  
ulna**





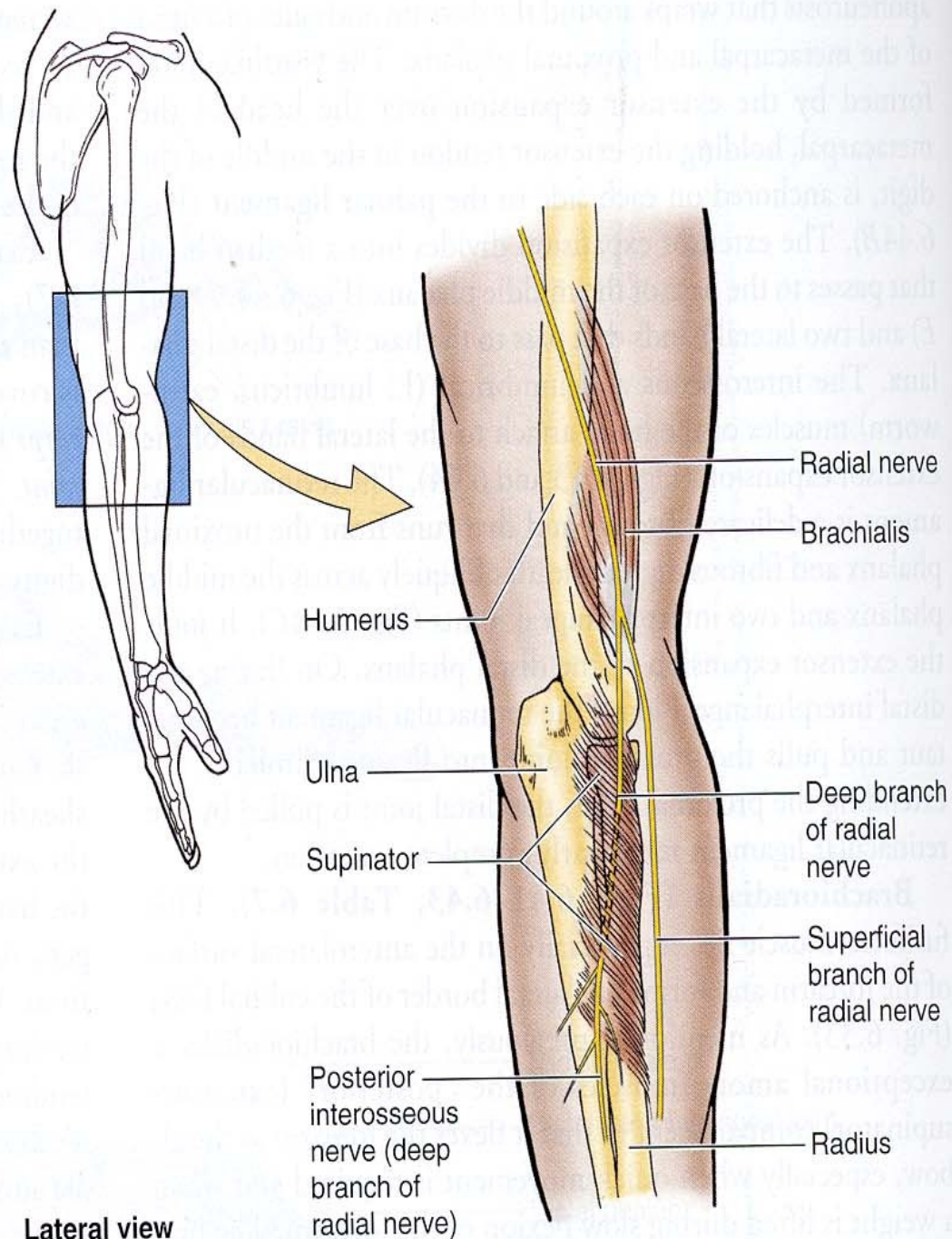
# Nerve Supply To Forearm Muscles

- Interosseous nerve (branch of Radial)
  - Extensor digitorum
  - Extensor carpi ulnaris
  - Abductor pollicis longus
  - Extensor pollicis brevis & longus
  - Extensor indicis

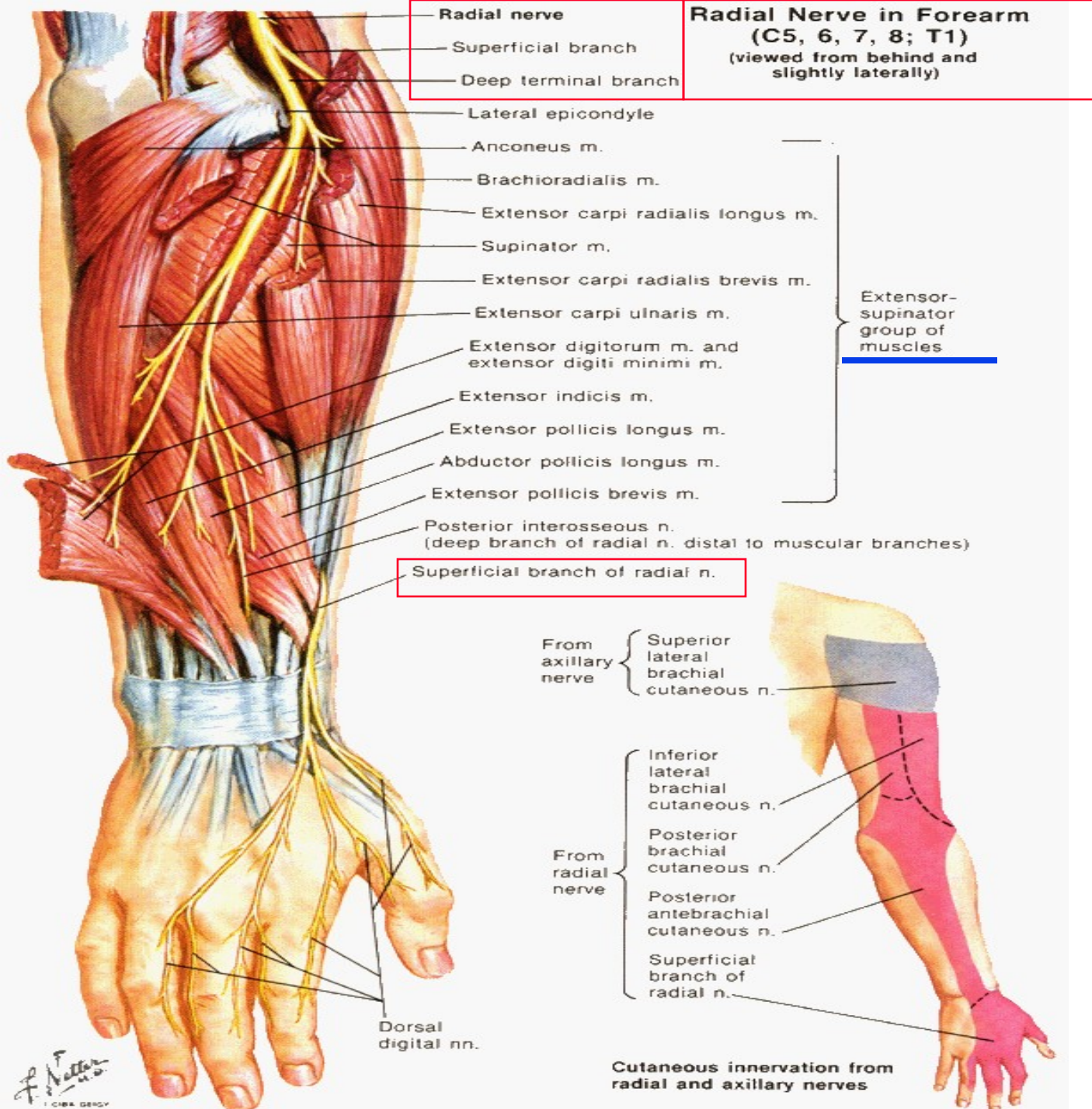


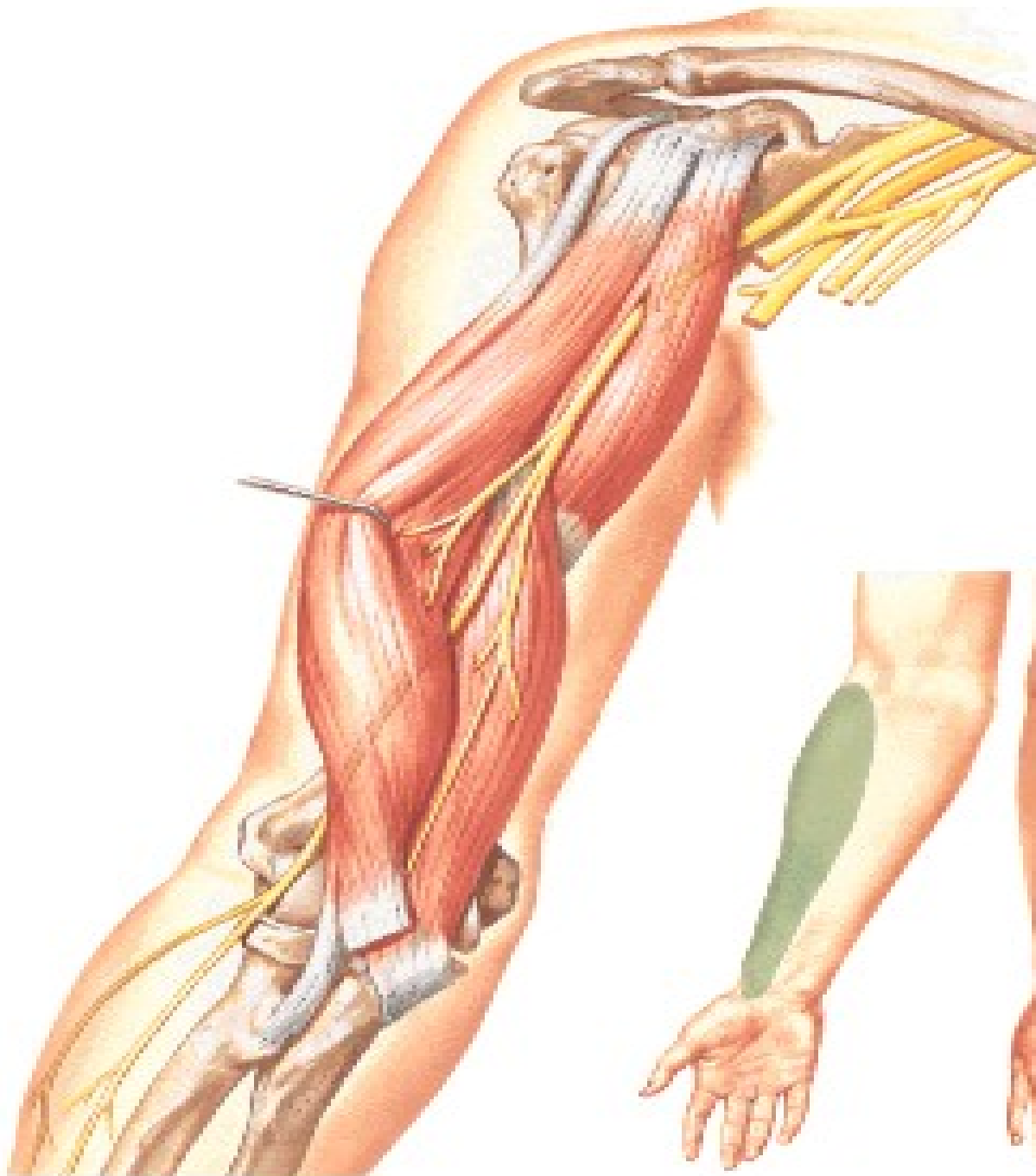
**Figure 6.45. Relationship of the radial nerve to the brachialis and supinator muscles.**

When the radial nerve reaches the distal third of the humerus, it passes from the posterior to the anterior fascial compartment by piercing the lateral intermuscular septum. The nerve then runs between the brachialis and brachioradialis muscles across the anterior aspect of the lateral epicondyle. The *radial nerve* divides in the cubital fossa into motor (deep) and sensory (superficial) branches. The deep branch penetrates the supinator muscle to reach the posterior compartment of the forearm. Beginning at the inferior end of the supinator, the deep branch of the radial nerve is called the posterior interosseous nerve as it begins to course with the artery of the same name.





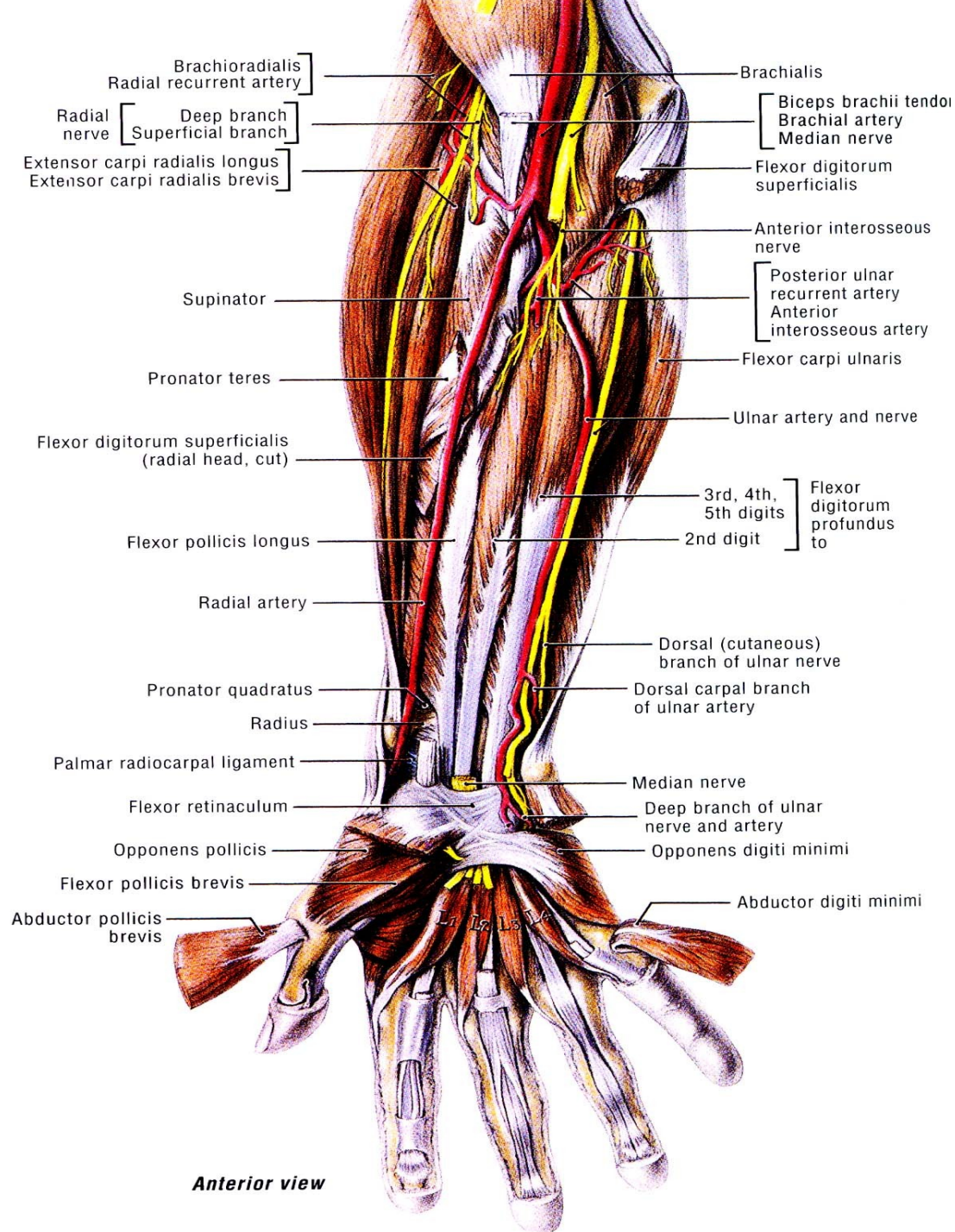




## **Musculocutaneous nerve**

- 1. Flexor muscles of upper**
- 2. Skin as:  
Lateral antebrachial  
cutaneous nerve**





# Innervation of Skin: Dermatomes

Supraclavicular nerves  
(from cervical plexus - C3,4)

Superior lateral cutaneous nerve  
of arm (from axillary nerve - C5,6)

Inferior lateral cutaneous nerve  
of arm (from radial nerve - C5,6)

Intercostobrachial nerve (T2) and medial  
cutaneous nerve of arm (C8,T1,2)

Lateral cutaneous nerve of forearm (terminal  
part of musculocutaneous nerve - C5,6,[7])

Medial cutaneous nerve of forearm (C8,T1)

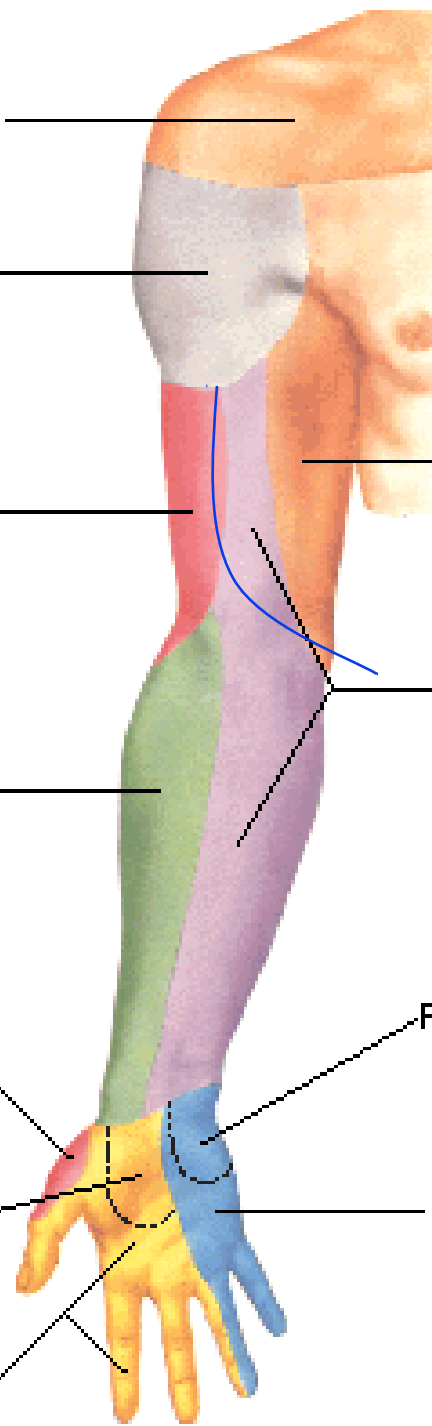
Superficial branch of radial nerve (C6,7,8)

Palmar branch of ulnar nerve (C8,T1)

Palmar branch of median nerve (C6,7,8)

Palmar digital branches of ulnar nerve (C8,T1)

Palmar digital branches of median nerve (C6,7,8)



Superior lateral cutaneous nerve of arm (from axillary nerve - C5,6)

Supraclavicular nerves (from cervical plexus - C3,4)

Intercostobrachial nerve (T2) and medial cutaneous nerve of arm (C8,T1,2)

Posterior cutaneous nerve of arm (from radial nerve - C5,6,7,8)

Posterior cutaneous nerve of forearm (from radial nerve - C[5],6,7,8)

Inferior lateral cutaneous nerve of arm (from radial nerve)

Medial cutaneous nerve of forearm (C8,T1)

Lateral cutaneous nerve of forearm (terminal part of musculocutaneous nerve - C5,6,[7])

Dorsal branch and dorsal digital branches of ulnar nerve (C8,T1)

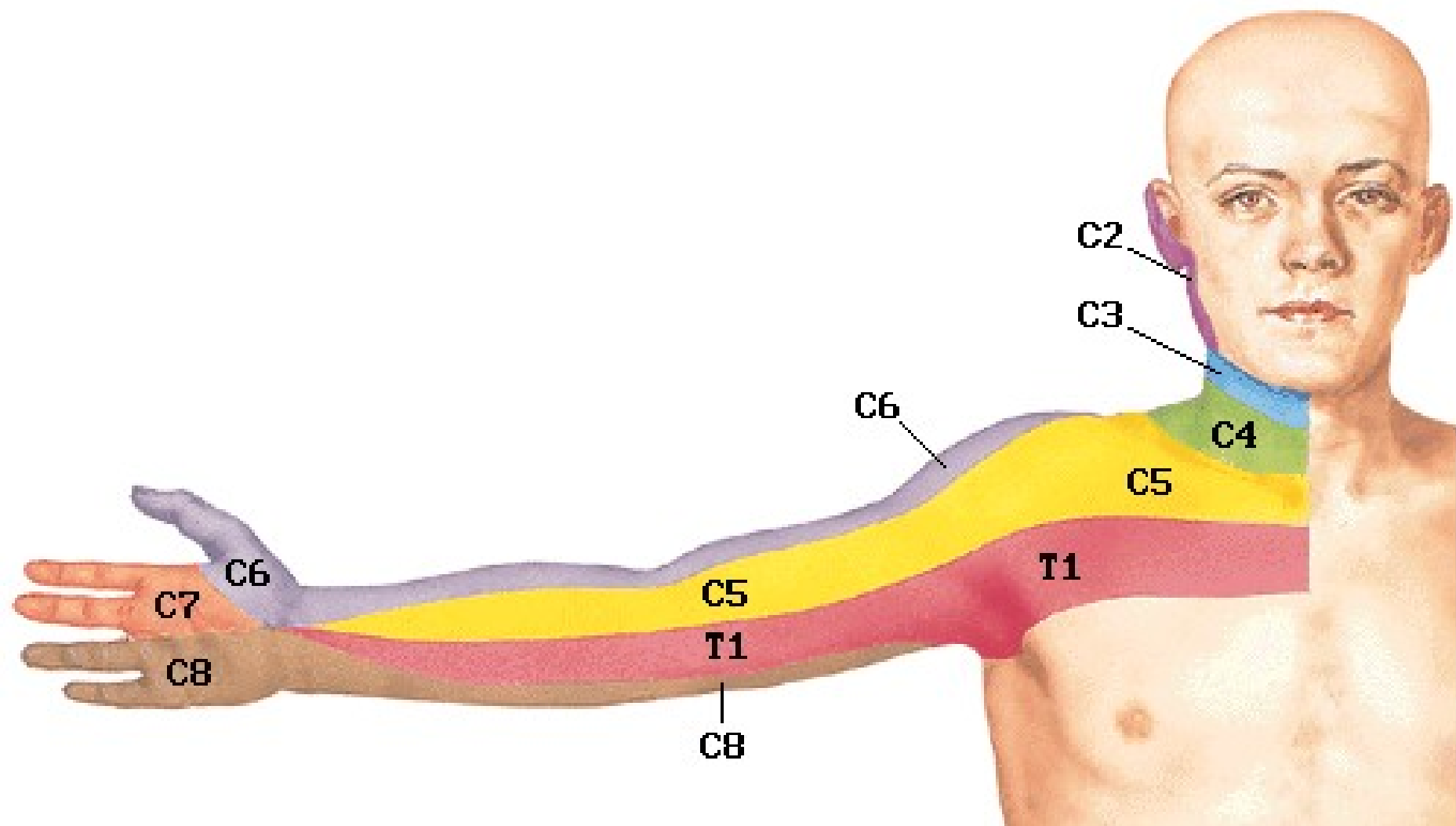
Proper palmar digital branches of ulnar nerve (C8,T1)

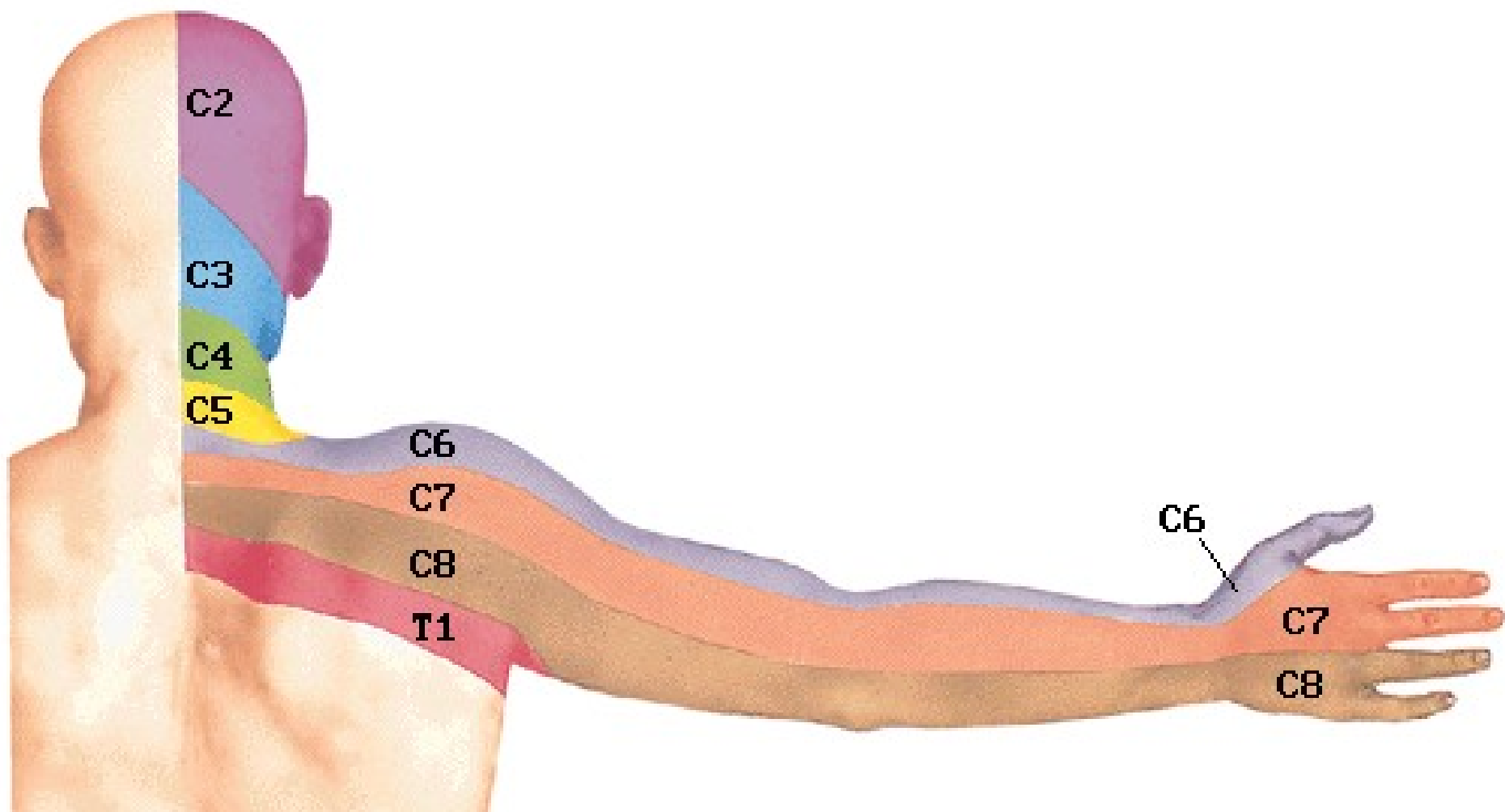
Superficial branch and dorsal digital branches of radial nerve (C6,7,8)

Proper palmar digital branches of median nerve

Division variable between ulnar and radial  
injection on dorsum of hand and often aligns with  
of 3rd digit instead of 4th digit as shown









**QUESTIONS**

# **THE WRIST and HAND**

Anatomy & Physiology I



(a)

Gliding





# **EXTENSORS OF THE WRIST and DIGITS**

**(Posterior  
compartment)**

# Extensors of The Wrist

- Superficial Extensor of the Wrist
  - Extensor carpi radialis longus
  - Extensor carpi radialis brevis
  - Extensor carpi ulnaris
- Deep Extensor of the Wrist (NONE)

# Extensors of The Digits

- Superficial Extensor of the Digits
  - Extensor digitorum
  - Extensor digiti minimi
- Deep Extensor of the Digits
  - Extensor indicis
  - Extensor pollicis longus
  - Extensor pollicis brevis

# Extensors of The Digits

- Extensors of the Thumb
  - Abductor pollicis longus
  - Extensor pollicis brevis
  - Extensor pollicis longus

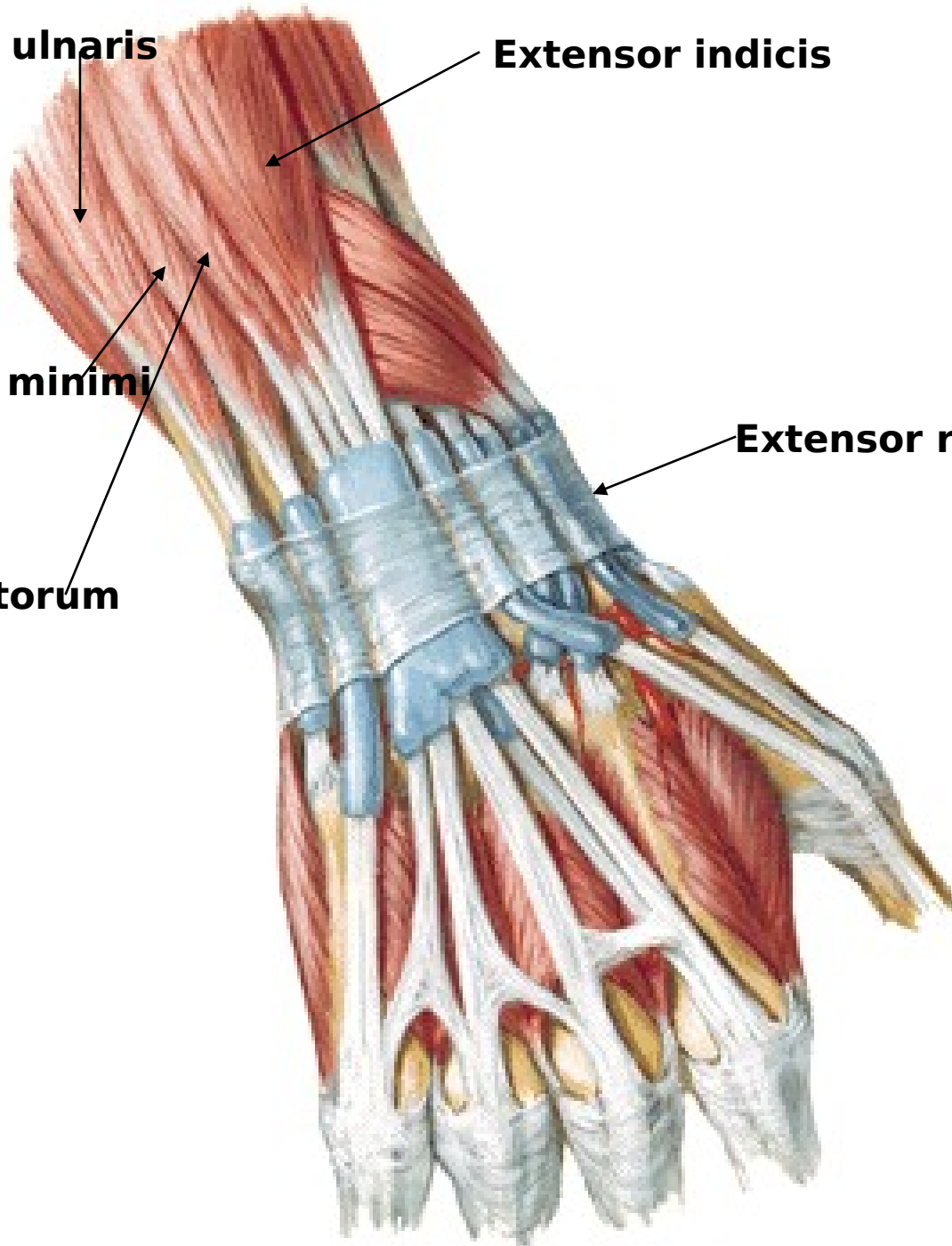
**Extensor carpi ulnaris**

**Extensor indicis**

**Extensor digiti minimi**

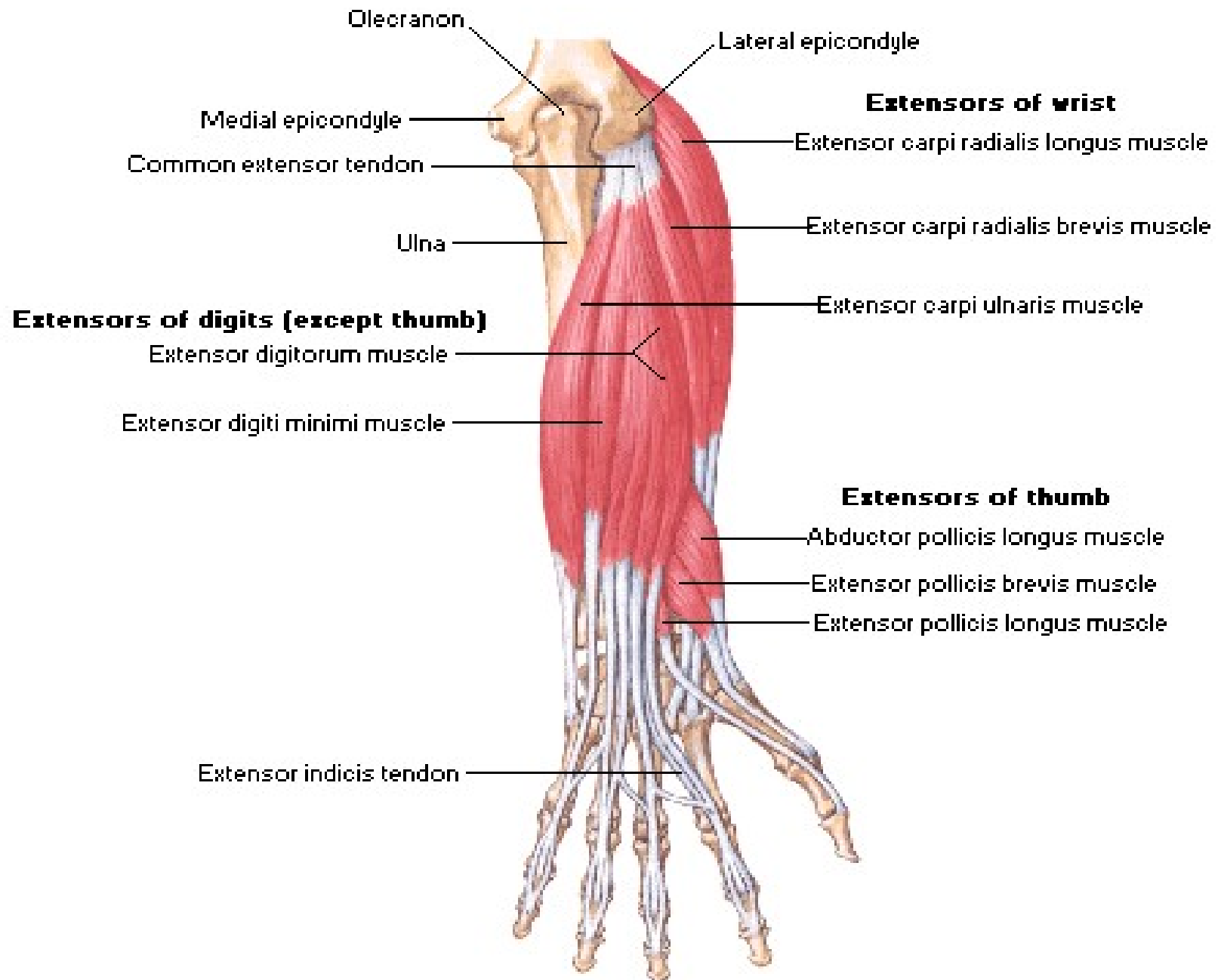
**Extensor retinaculum**

**Extensor digitorum**

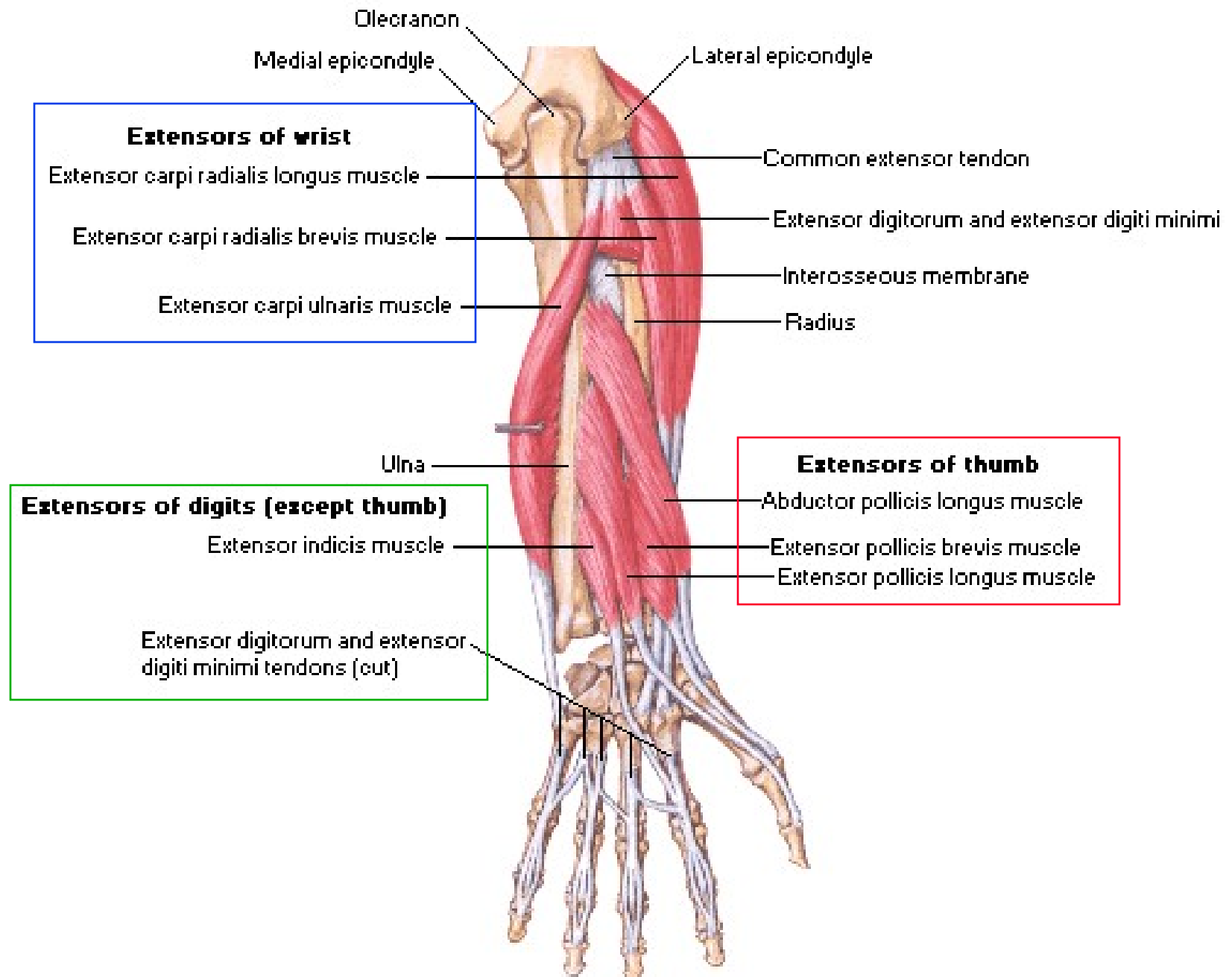




# Superficial Extensors of Wrist and Digits



# Extensors of Wrist and Digits



# **FLEXORS OF THE WRIST**

**and**

# **DIGITS**

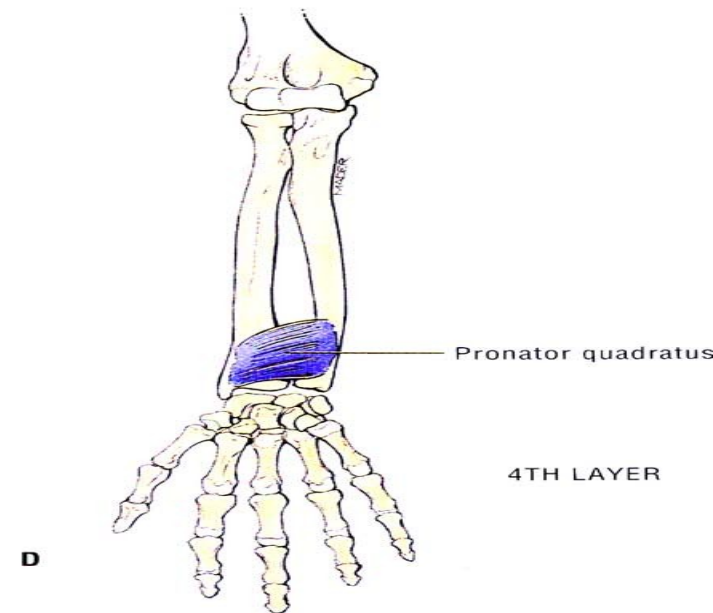
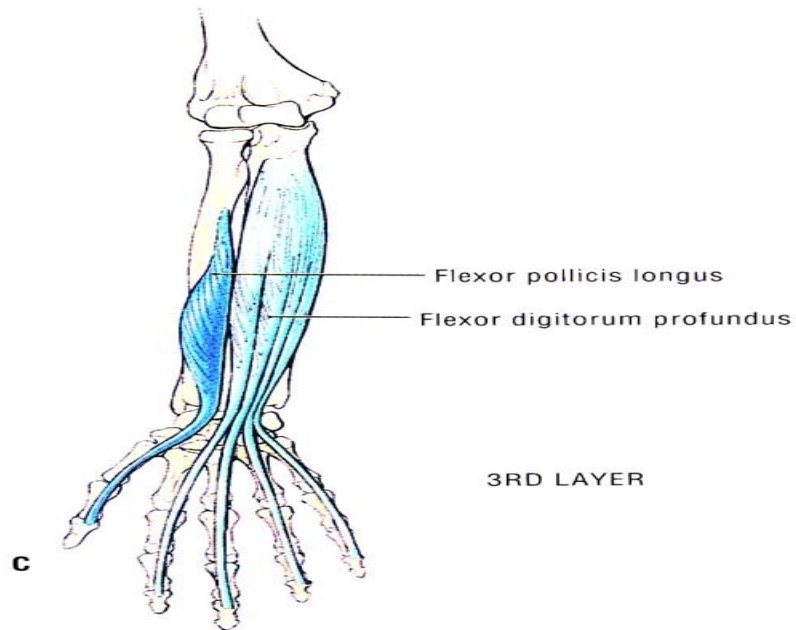
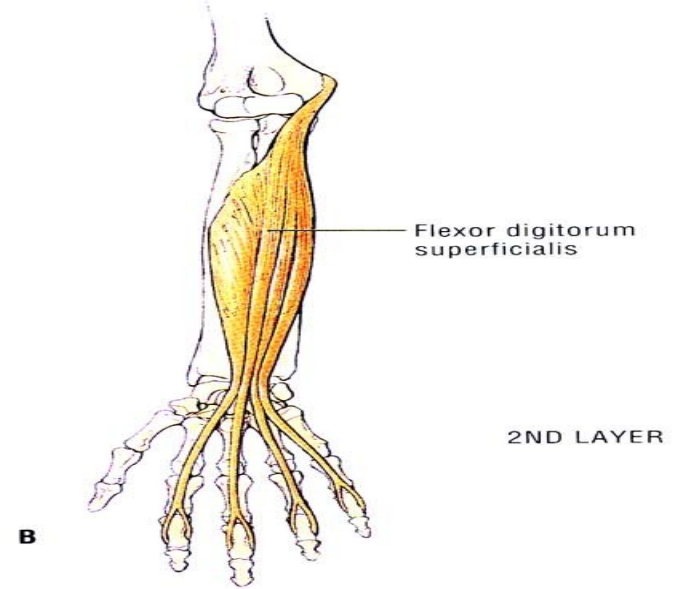
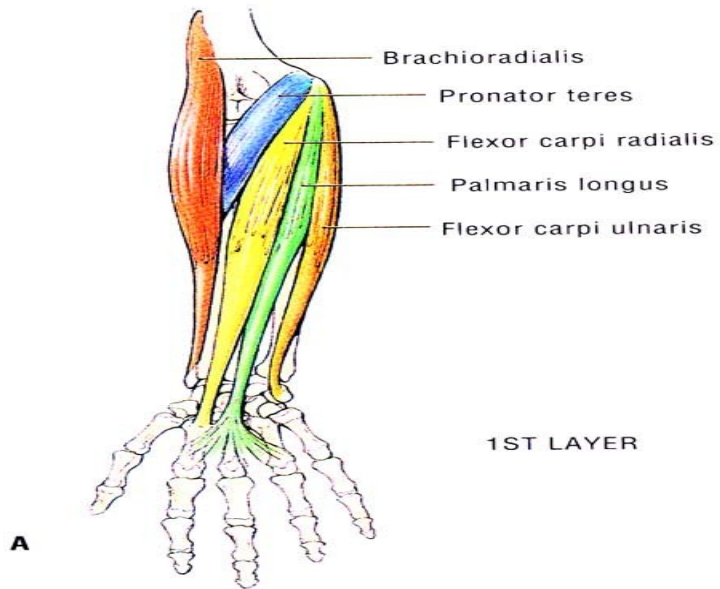
(Anterior  
compartment)

# Anterior Muscles

- Superficial Muscles:
  - Flexor carpi radialis - wrist
  - Palmaris longus (weak flexor; tenses CT of palm)
  - Flexor carpi ulnaris - wrist
  - Flexor digitorum superficialis - digits

# Anterior Muscles

- Deep Muscles:
  - Flexor pollicis longus - digits
  - Flexor digitorum profundus - digits
  - Pronator quadratus (PM of pronation)



### 6.78 Four layers of anterior forearm muscles

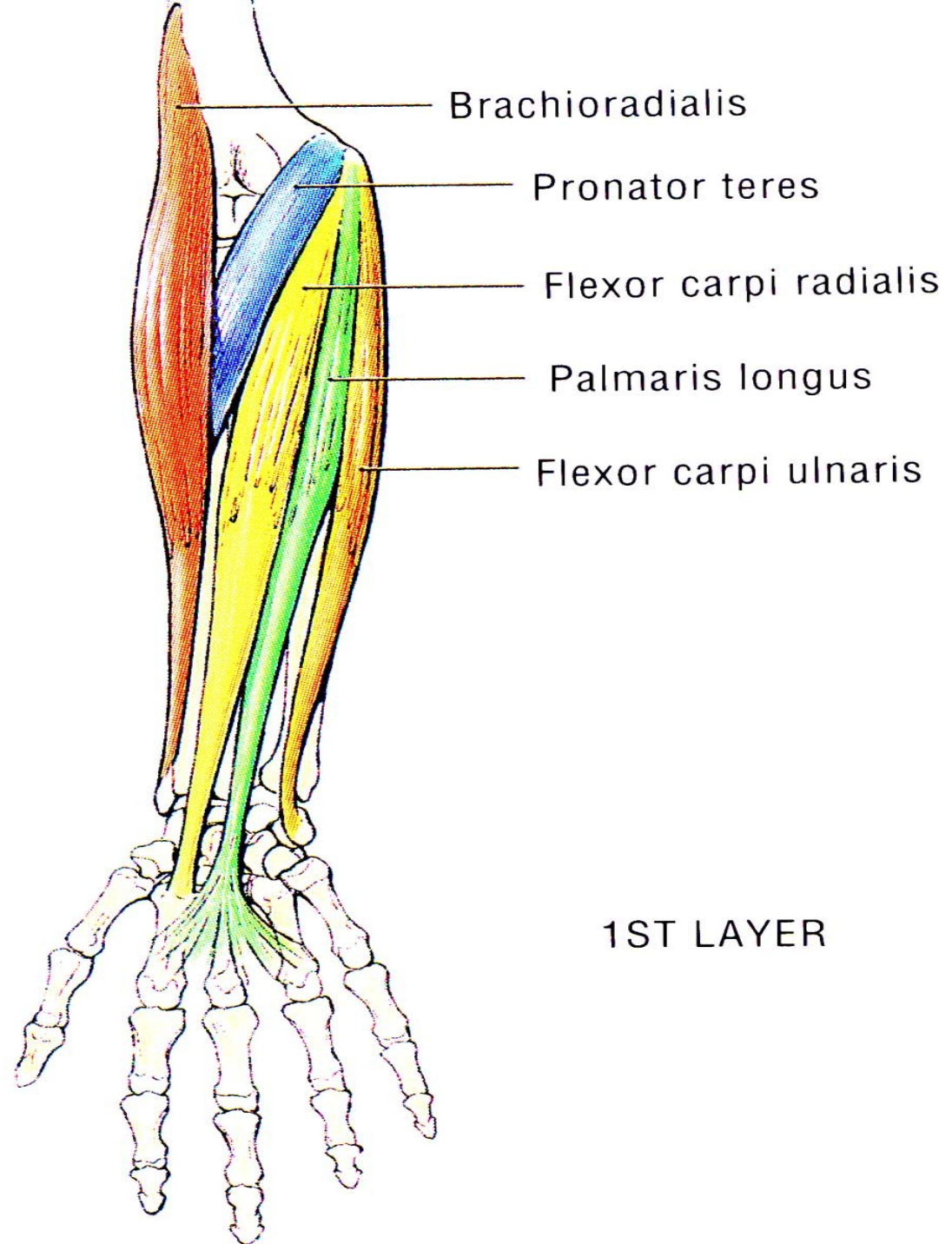
Examine these four diagrams arranged sequentially from superficial to deep, in relation to the origins and insertions shown in Figure 6.77. **A.** First (most superficial) layer. **B.** Second layer. **C.** Third layer. **D.** Fourth (deepest) layer.



# Anterior Muscles

- 1st Layer

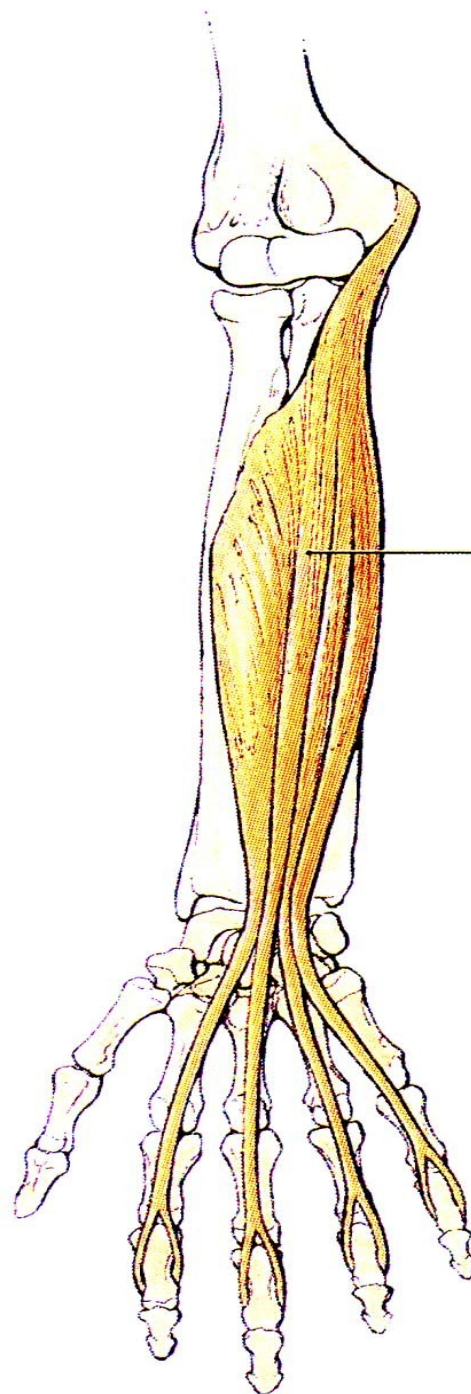
- Pronator teres (a pronator)
- Flexor carpi radialis - wrist
- Palmaris longus (weak)
  - Flexes hand & tightens palmar aponeurosis
- Flexor carpi ulnaris - wrist



**A**

# Anterior Muscles

- 2nd Layer
  - Flexor digitorum superficialis
    - digits



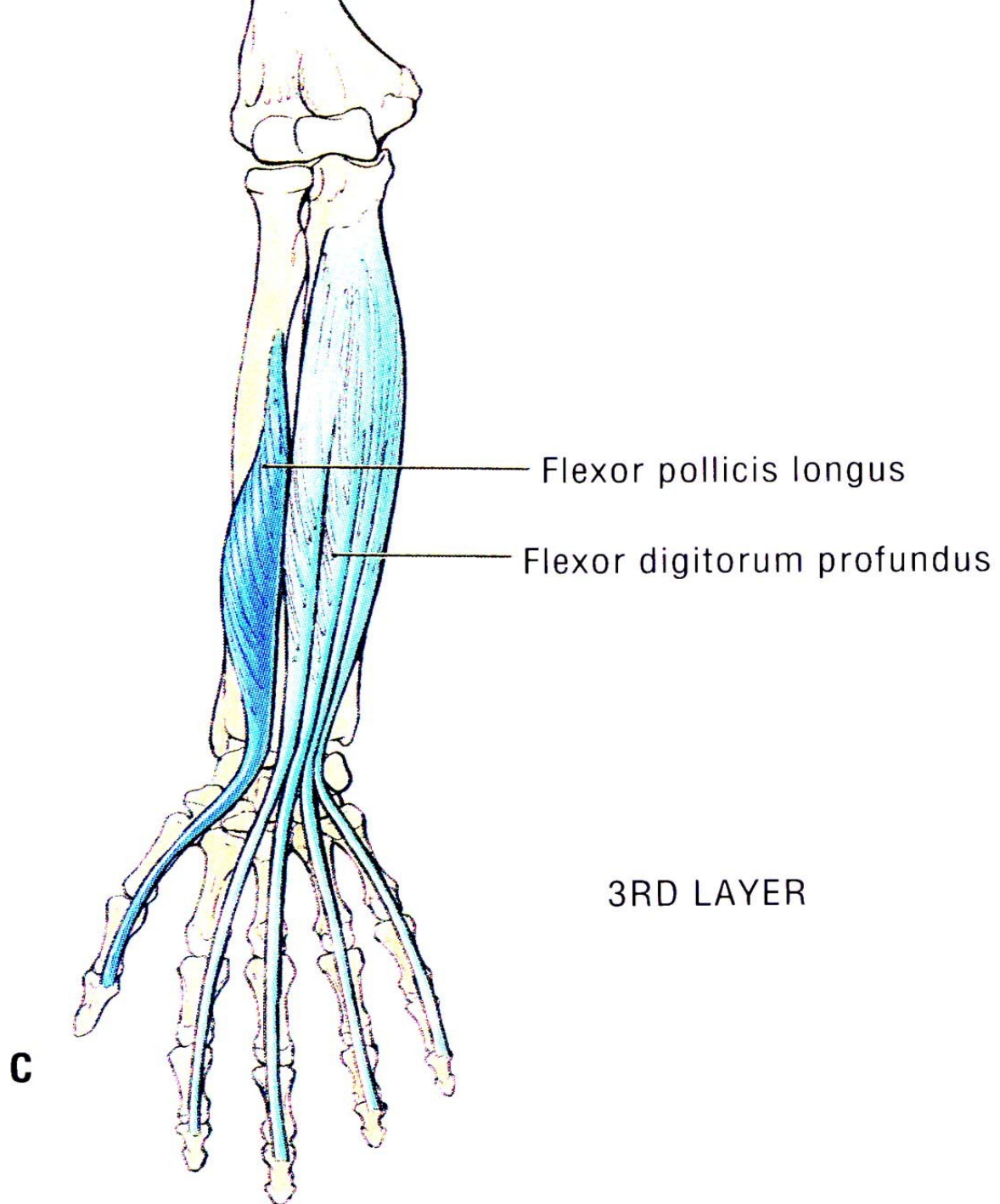
Flexor digitorum  
superficialis

2ND LAYER

**B**

# Anterior Muscles

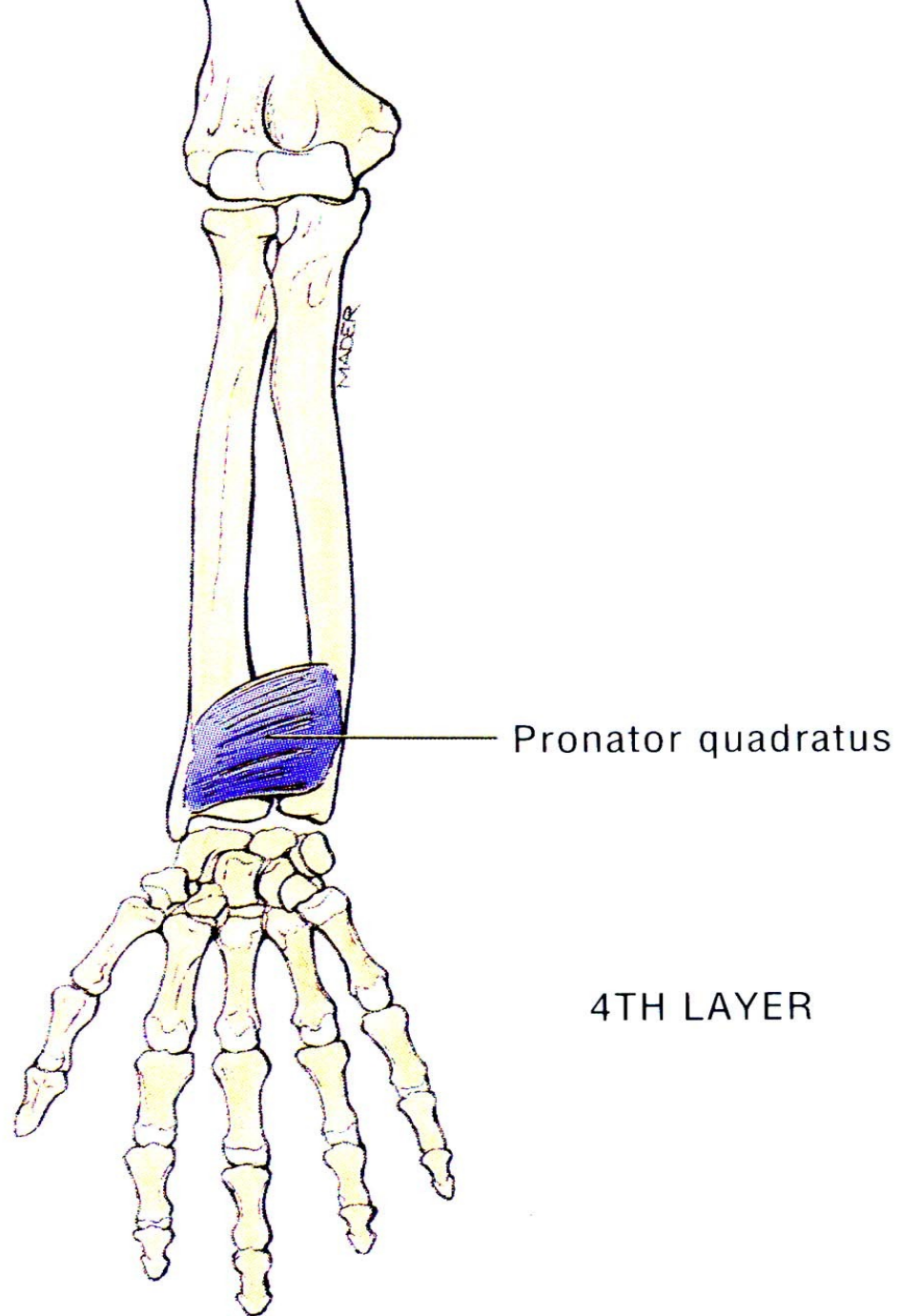
- 3rd Layer -
  - Flexor digitorum profundus - digits
  - Flexor pollicis longus - digits





# Anterior Muscles

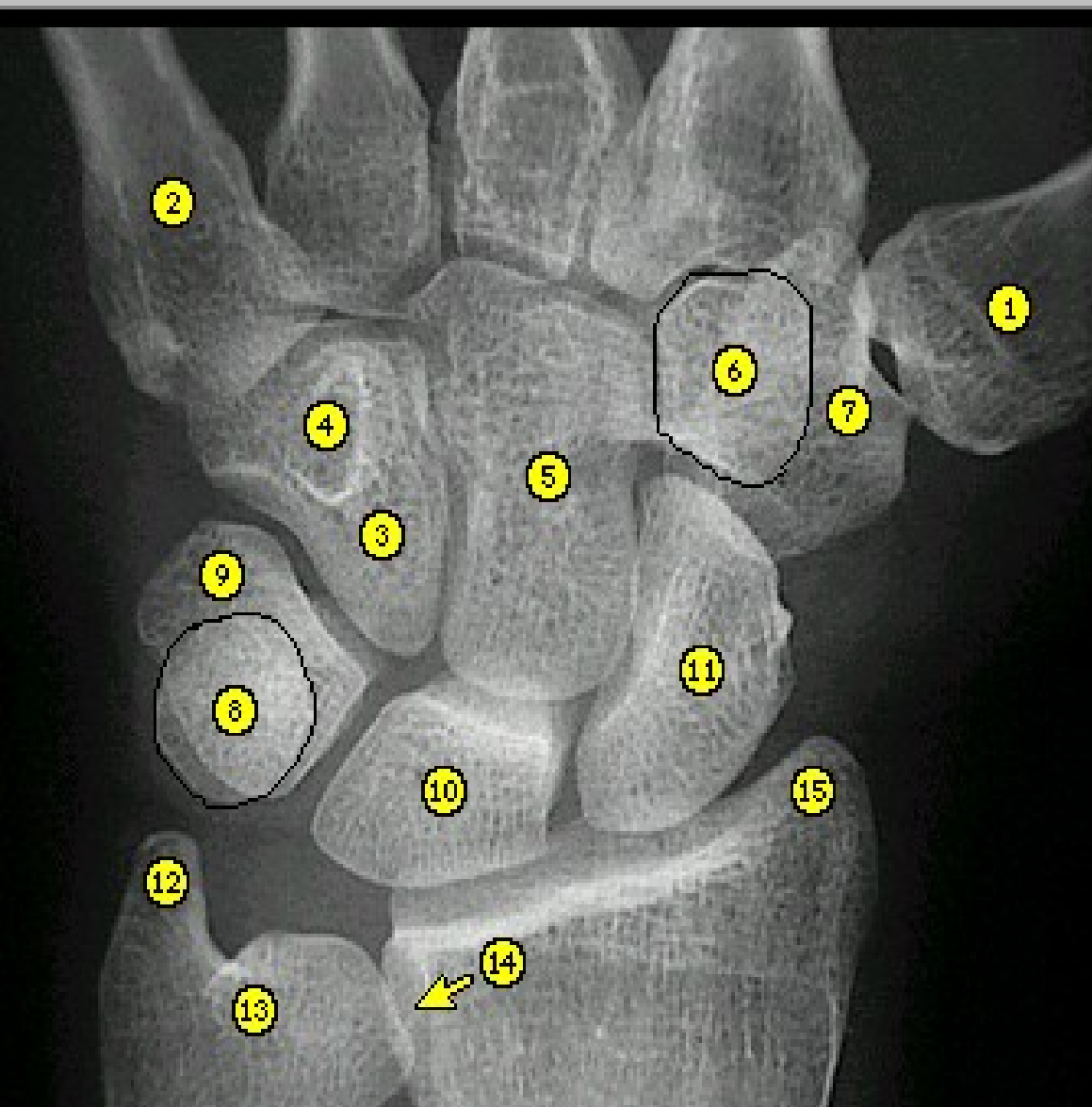
- 4th Layer
  - Pronator quadratus (PM  
-pronation)



# **CARPAL and METACARPAL BONES**



## PA Wrist



## Bones and Joints

- 1-1st metacarpal
- 2-5th metacarpal
- 3-body of hamate
- 4-hook of hamate
- 5-capitate
- 6-trapezoid
- 7-trapezium
- 8-pisiform
- 9-triquetrum
- 10-lunate
- 11-scaphoid
- 12-ulnar styloid
- 13-ulnar head
- 14-ulnar notch of radius
- 15-radial styloid

## PA Wrist



## Hamate

1-body

2-hook

The most medial of the distal row of carpals, the hamate appears triangular on frontal view. The superimposed circular density represents the "hook" on the palmar side of the hamate. The two rows of carpal bones are attached by ligaments and they articulate with each other at synovial joints. The hamate articulates distally with the fourth and fifth metacarpals.



## PA Wrist



## Metacarpal

1-1st

2-5th

The metacarpals are the long bones of the hand. They articulate proximally with the carpals at the carpometacarpal joint, which is a synovial joint. The metacarpals are numbered I-V from lateral (thumb) to medial. Take note of the distal row of carpals and the metacarpals with which each articulates.

## PA Wrist



## Lunate

The lunate lies medial to the scaphoid in the proximal row of carpals. It lies between the radius and the capitate along the "median ray" of the hand and wrist. It articulates proximally with the radius at the wrist (radiocarpal) joint and distally with the capitate at the midcarpal joint. It is attached to surrounding carpals by ligaments and the fibers of the capsules.

## PA Wrist



## Pisiform

The pisiform bone is a pea-shaped bone included in the proximal row of carpal bones. It lies on the palmar side of the triquetrum and is actually a sesamoid bone in the tendon of the flexor carpi ulnaris muscle. On the frontal view of the wrist, the pisiform is distal to the ulnar styloid and partially overlies the triquetrum.

## PA Wrist



## Capitate

The frontal view of the wrist shows that the capitate is the largest of the eight carpal bones. Two rows of carpal bones are attached by ligaments, and they articulate with each other at synovial joints. They are also enclosed within fibrous capsules, but these soft tissues are not apparent on plain film. The capitate aligns with the lunate and scaphoid bones in the proximal carpal row and articulates with them in the midcarpal joint. The capitate articulates distally with the third metacarpal at the CMC joint.

## PA Wrist



## Radius

1-styloid process

2-ulnar notch

The distal radius articulates with the scaphoid and lunate in the proximal row of carpals at the wrist joint. On the lateral side of the radius is a tapered process called the radial styloid, which serves as the attachment of the brachioradialis muscle. On the medial side of the distal radius there is a notch into which fits the head of the ulna, creating the radioulnar joint, which does not communicate with the wrist (radiocarpal) joint. The dense line across the distal radius represents the fused growth plate in this adult patient.

## PA Wrist



## Scaphoid

The scaphoid is an important carpal bone clinically. It is the most lateral of the proximal row of carpals and articulates proximally with the radius at the wrist joint. It also articulates at the midcarpal joint with the distal row of carpals. It is adjacent to the lunate. On the frontal view of the wrist, the distal scaphoid appears slightly denser than the proximal portion, since the bone is thicker distally. If clinically indicated, special views of the scaphoid can be obtained.



## PA Wrist



## Trapezium

The trapezium articulates distally with the thumb at the carpometacarpal joint. At one time it was called the "greater multangular" of the wrist. It is the most lateral of the distal row of carpals. In the frontal view of the wrist, the trapezium partially overlies the trapezoid.

## PA Wrist



## Trapezoid

The trapezoid, also called the "lesser multangular," is just medial to the trapezium in the distal row of carpals. On the frontal view of the wrist, it overlies the trapezium partially. It articulates with surrounding carpal bones and with the second metacarpal in synovial joints.

## PA Wrist



## Triquetrum

The triquetrum is medial in the proximal row of metacarpals. In the frontal view of the wrist, it is distal to the ulna and partially overlaps the pisiform bone. The "space" between the triquetrum and the distal ulna is filled with fibrocartilage, which is not seen on x-ray.

## PA Wrist



## Ulna

1-head

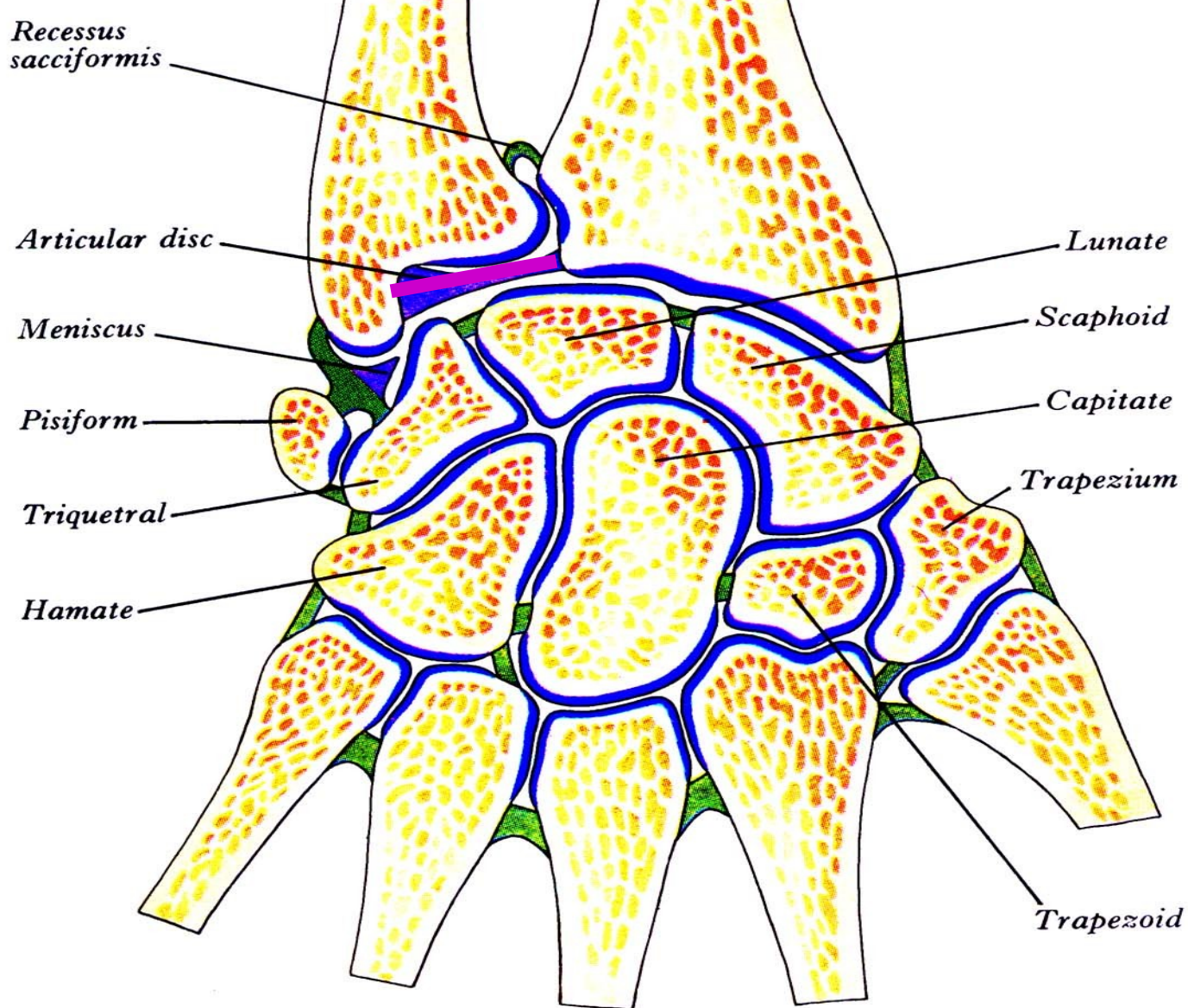
2-styloid process

The head of the ulna is at the distal end. The ulna articulates with the radius at the radioulnar joint, a synovial joint bound by a fibrocartilaginous disc that separates it from the wrist joint between the radius and proximal row of carpals. These structures are not visible on plain film, but can be imaged using contrast injected into the joints. The ulnar styloid projects medially.

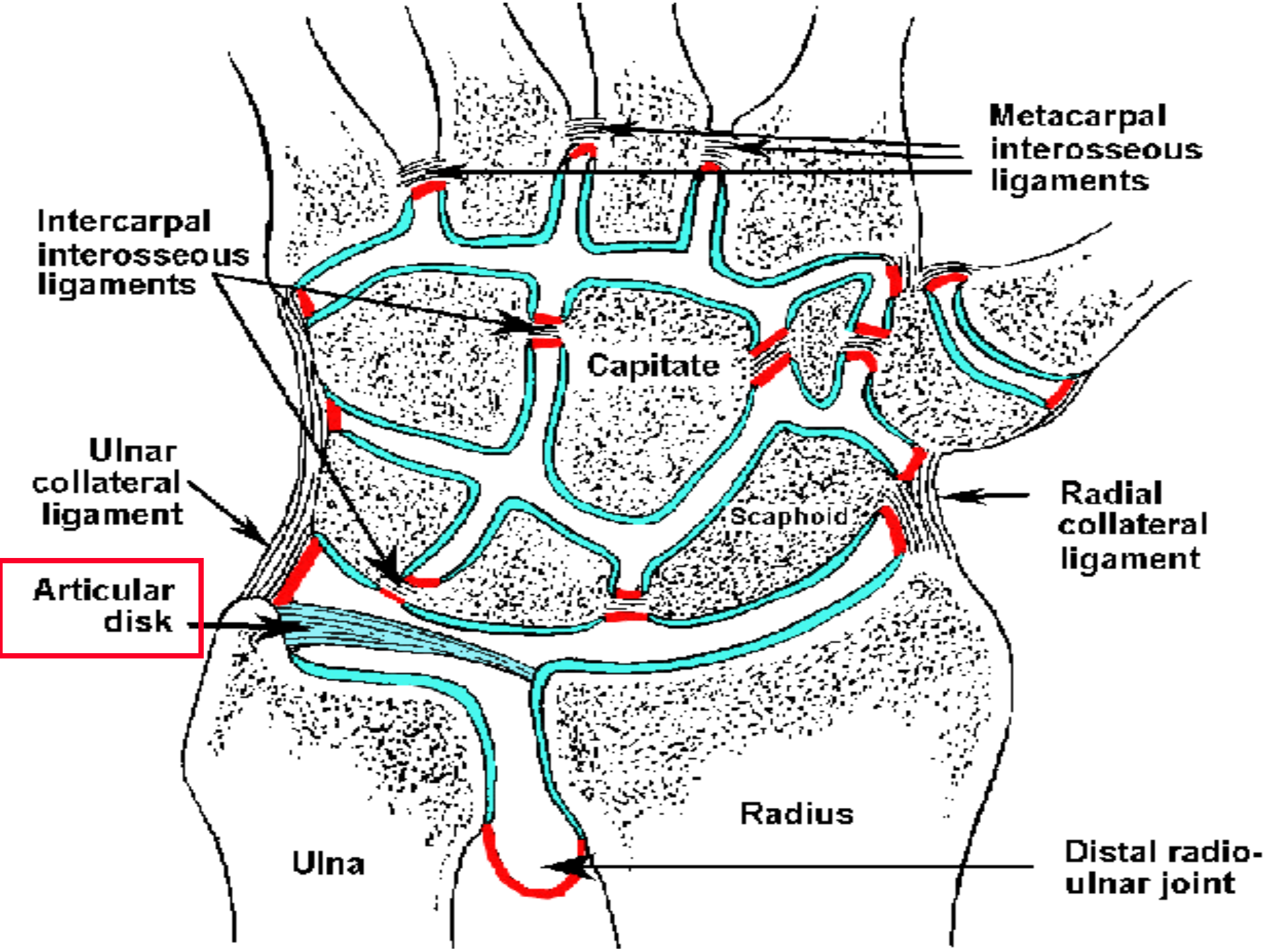


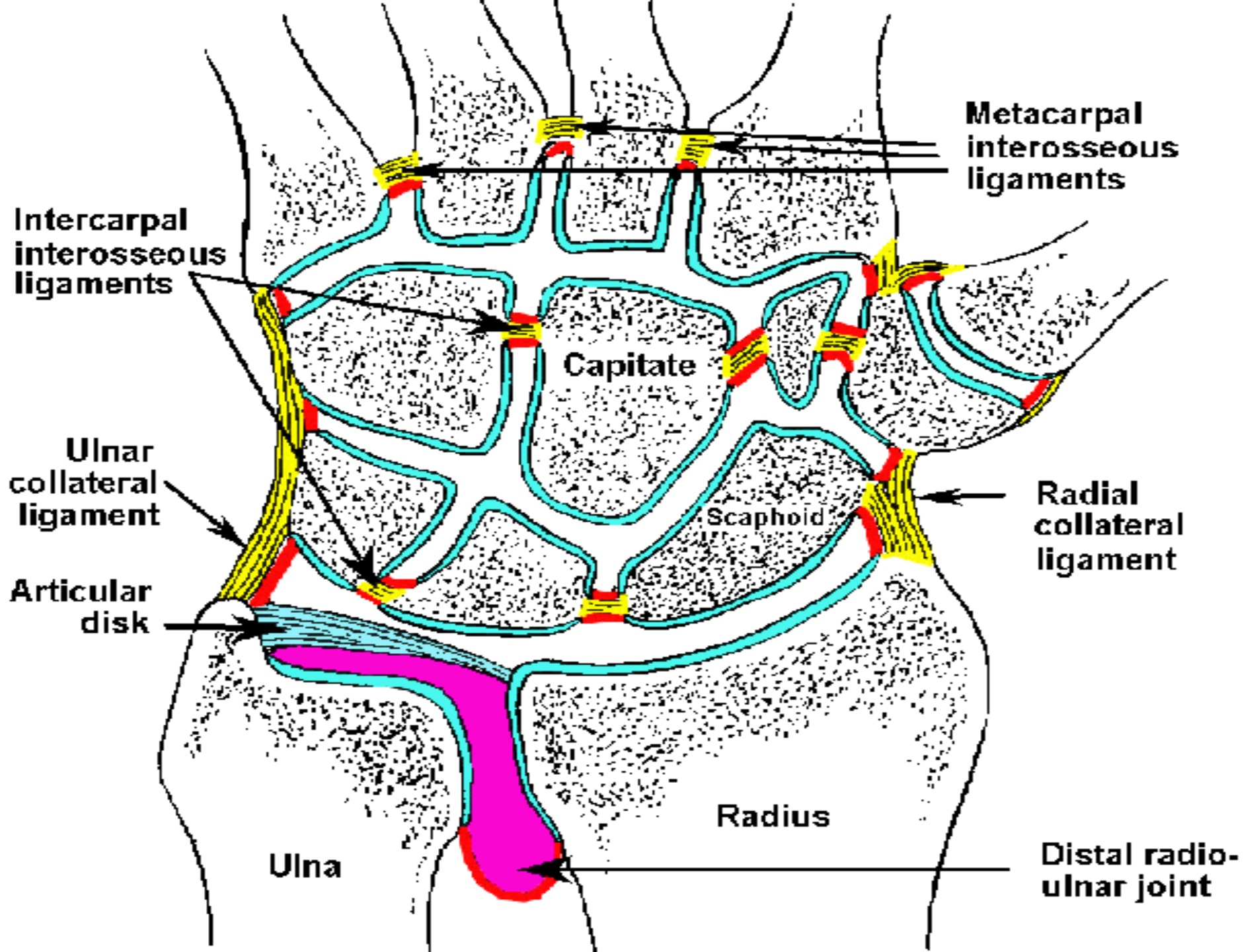
# **SYNOVAL CAVITIES OF THE WRIST**



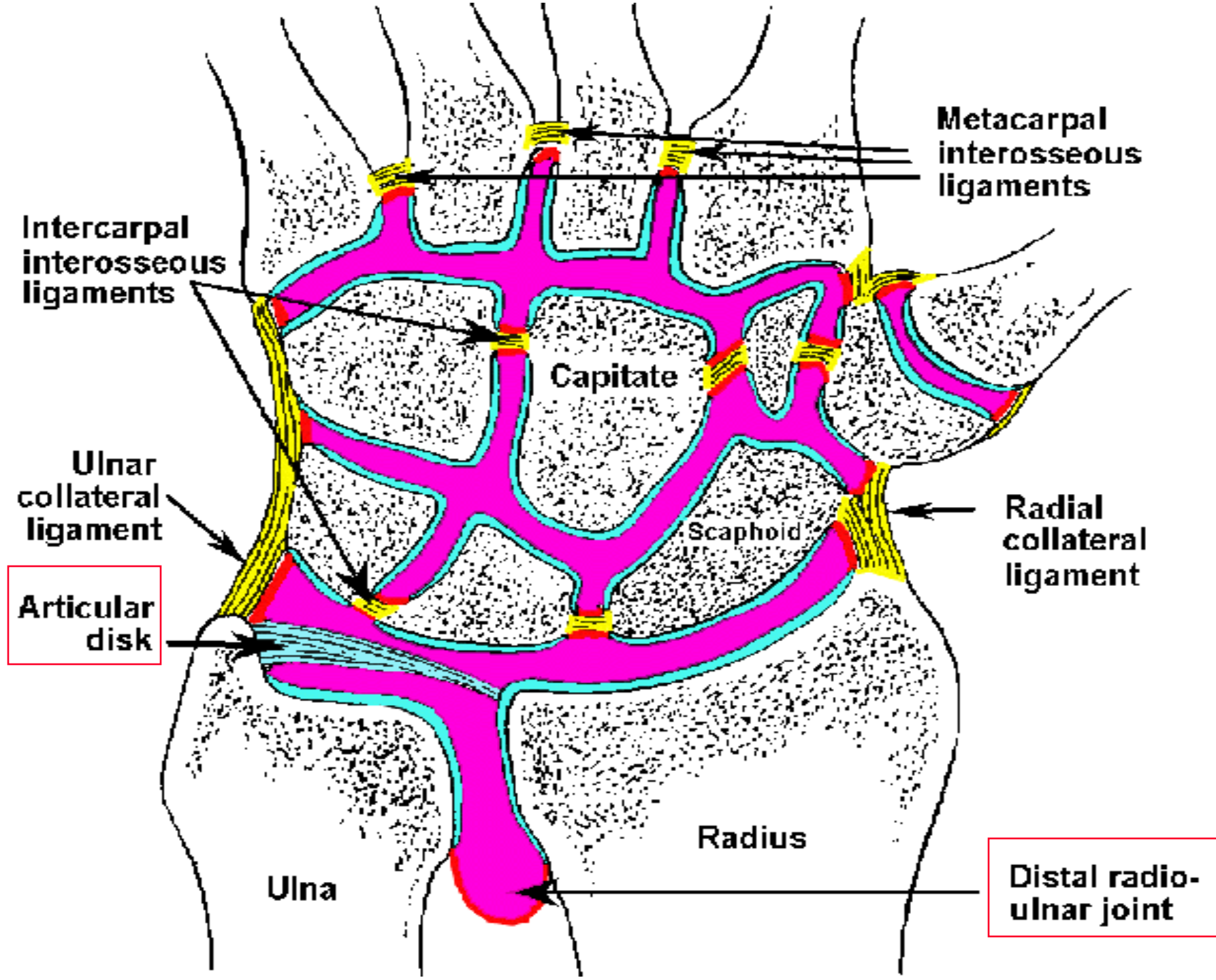


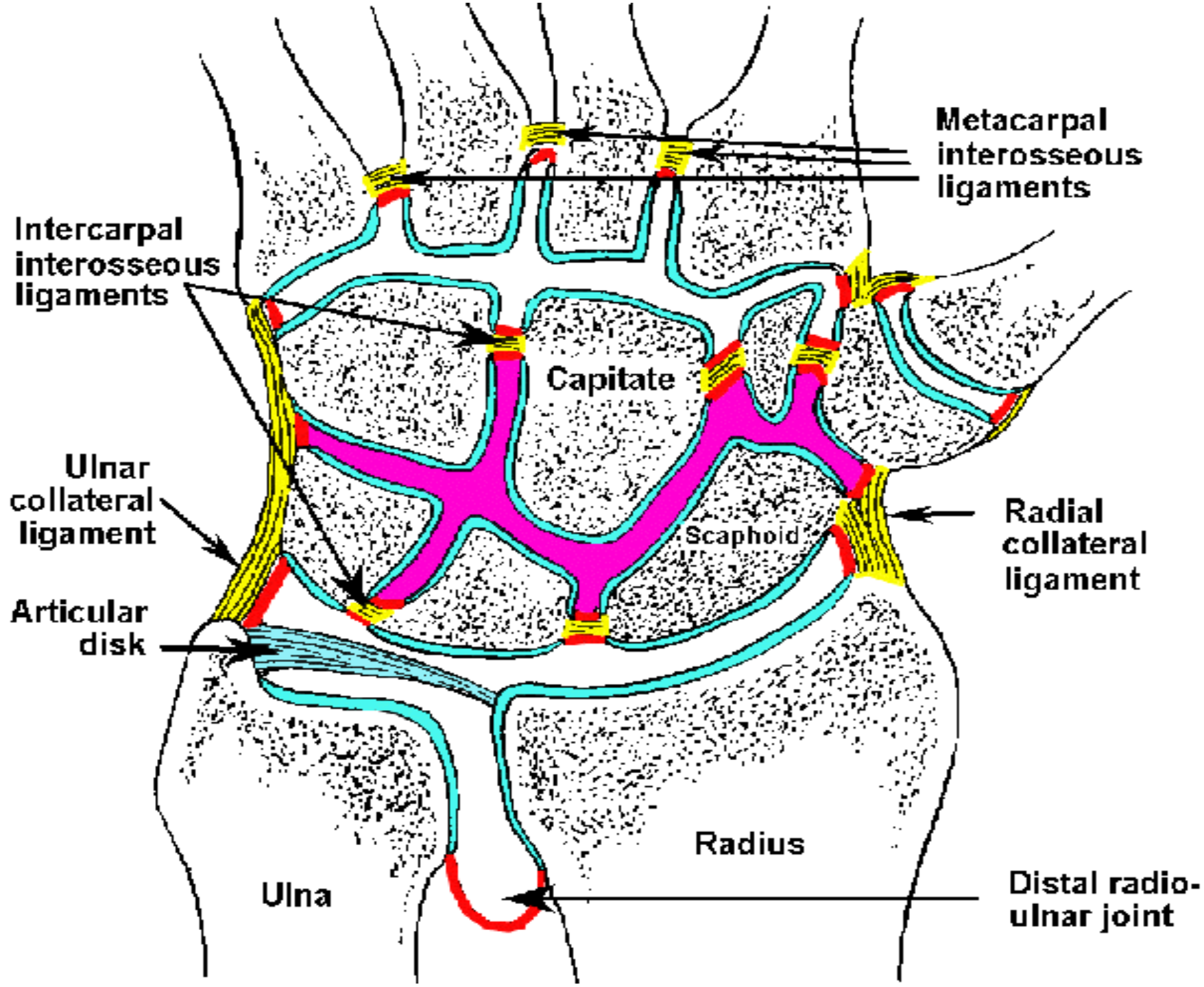
6.250 Coronal section through the distal ends of the radius and ulna, the carpus and the proximal ends of the metacarpals, showing the general form of the articular surfaces (blue), synovial cavities, interosseous ligaments (green) and fibrocartilages (purple). Partly after Lewis et al (1970).

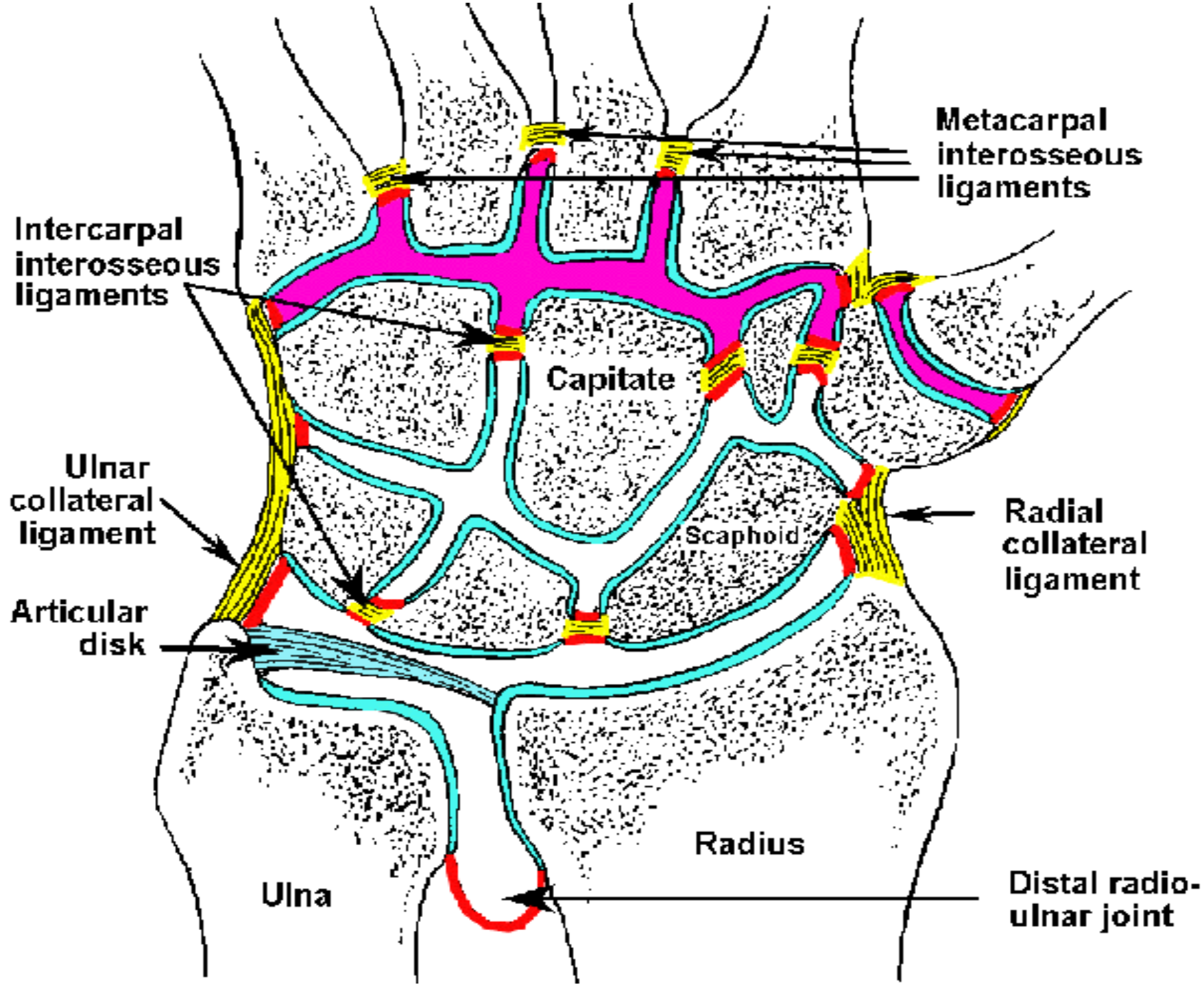


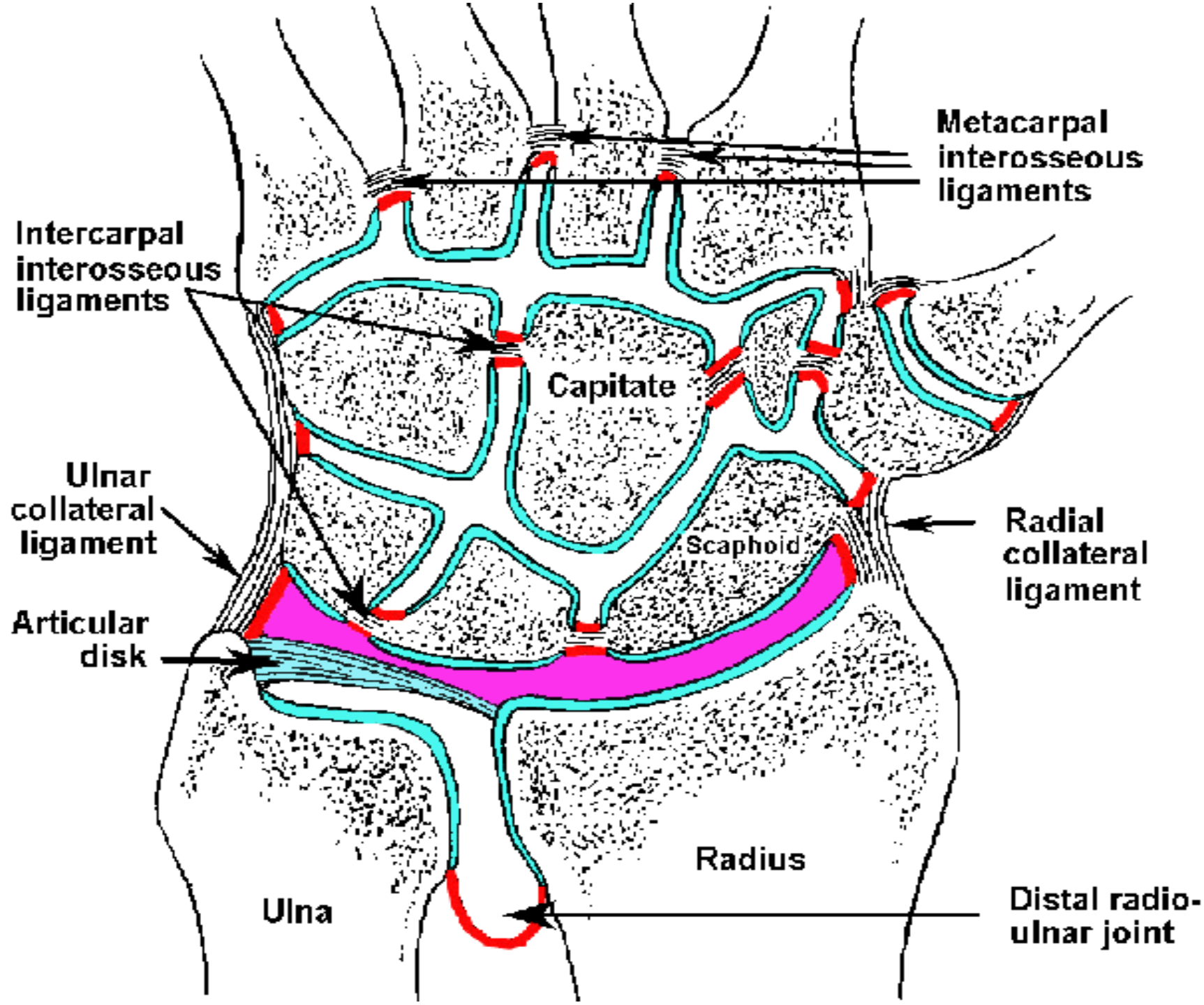








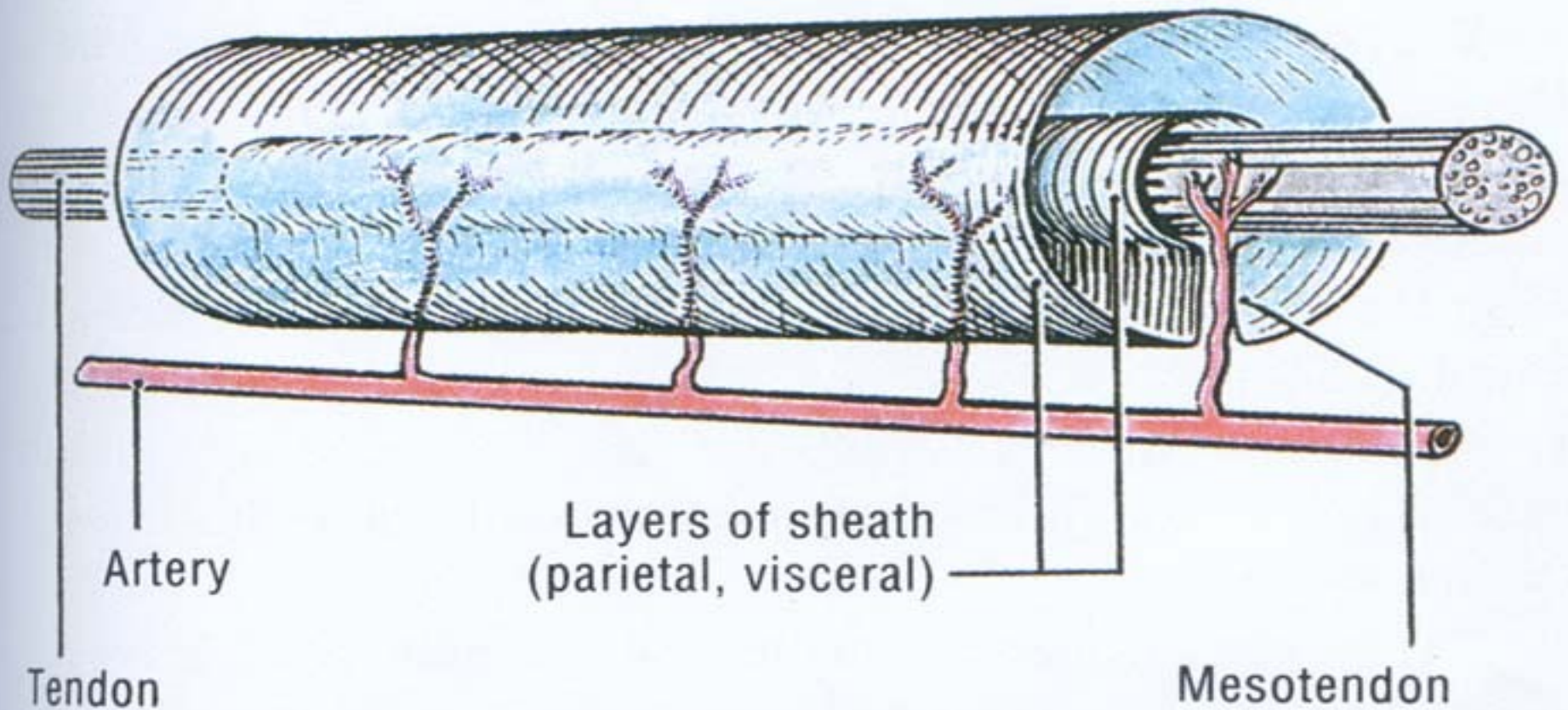






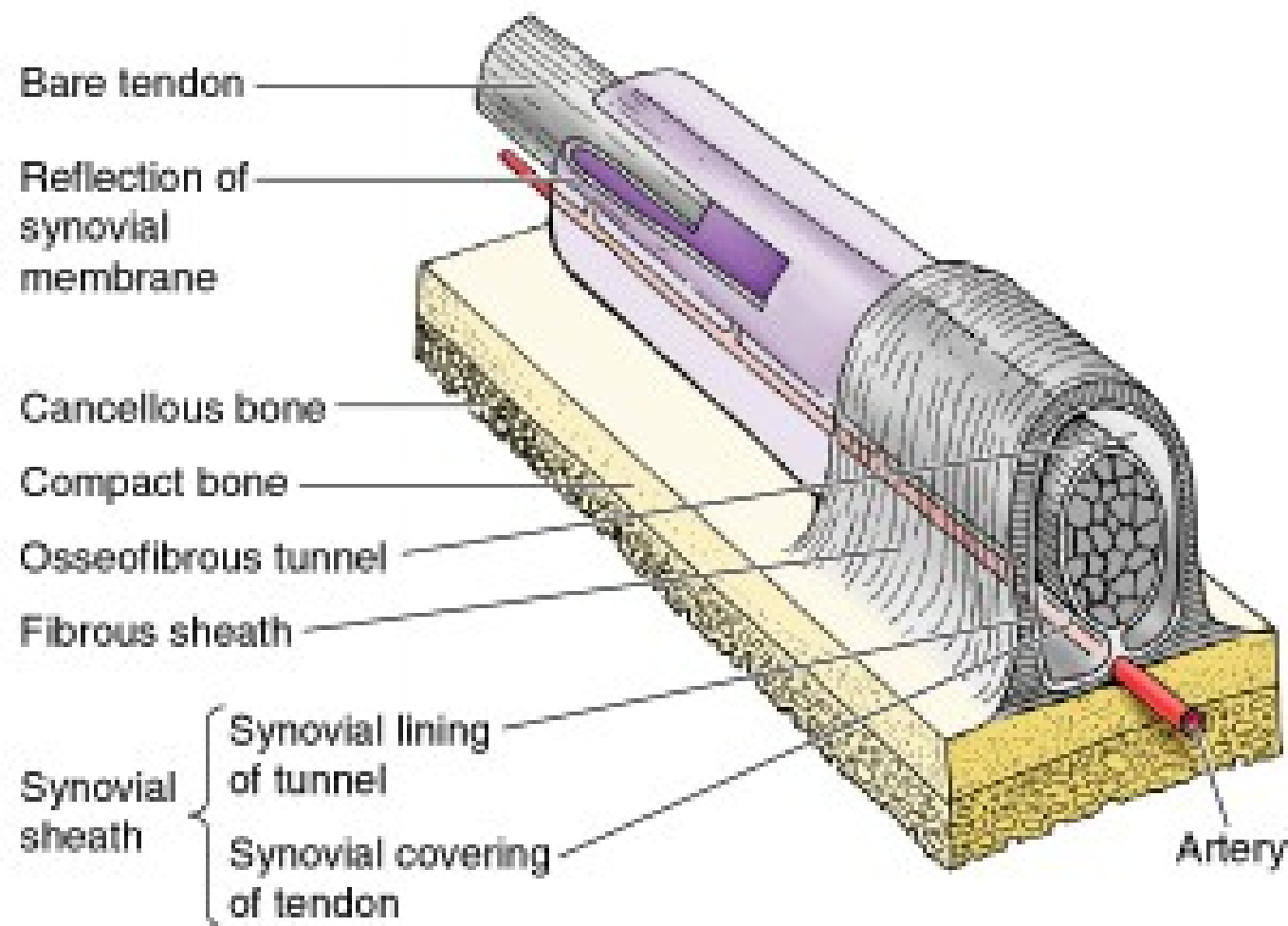
# **TENDONS and LIGAMENTS OF THE HAND**

# TENDON SHEATH



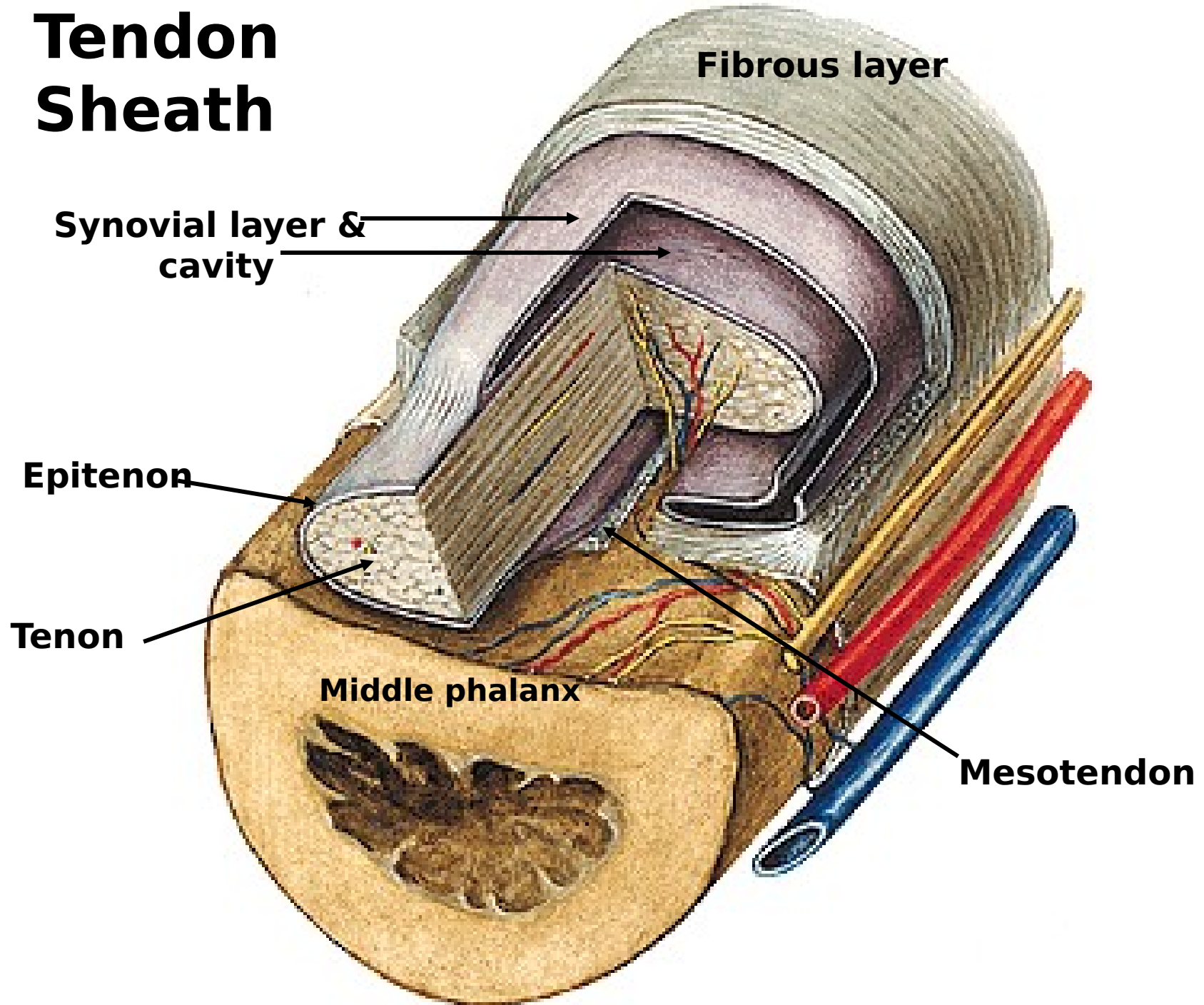
**Figure 6-79.** Synovial sheath of a long flexor tendon. The tubular sheath is a lubricating device (bursa) that envelops the long digital tendons where they pass through the osseofibrous tunnels in the digits (see Fig. 6-78). The layers of the synovial sheath are separated by a capillary layer of synovial fluid. Note that the mesotendon conveys small blood vessels to the tendons.

6.57B, C. Palm of hand: tendons, fibrous tendon sheaths; osseofibrous tunnel of a finger.

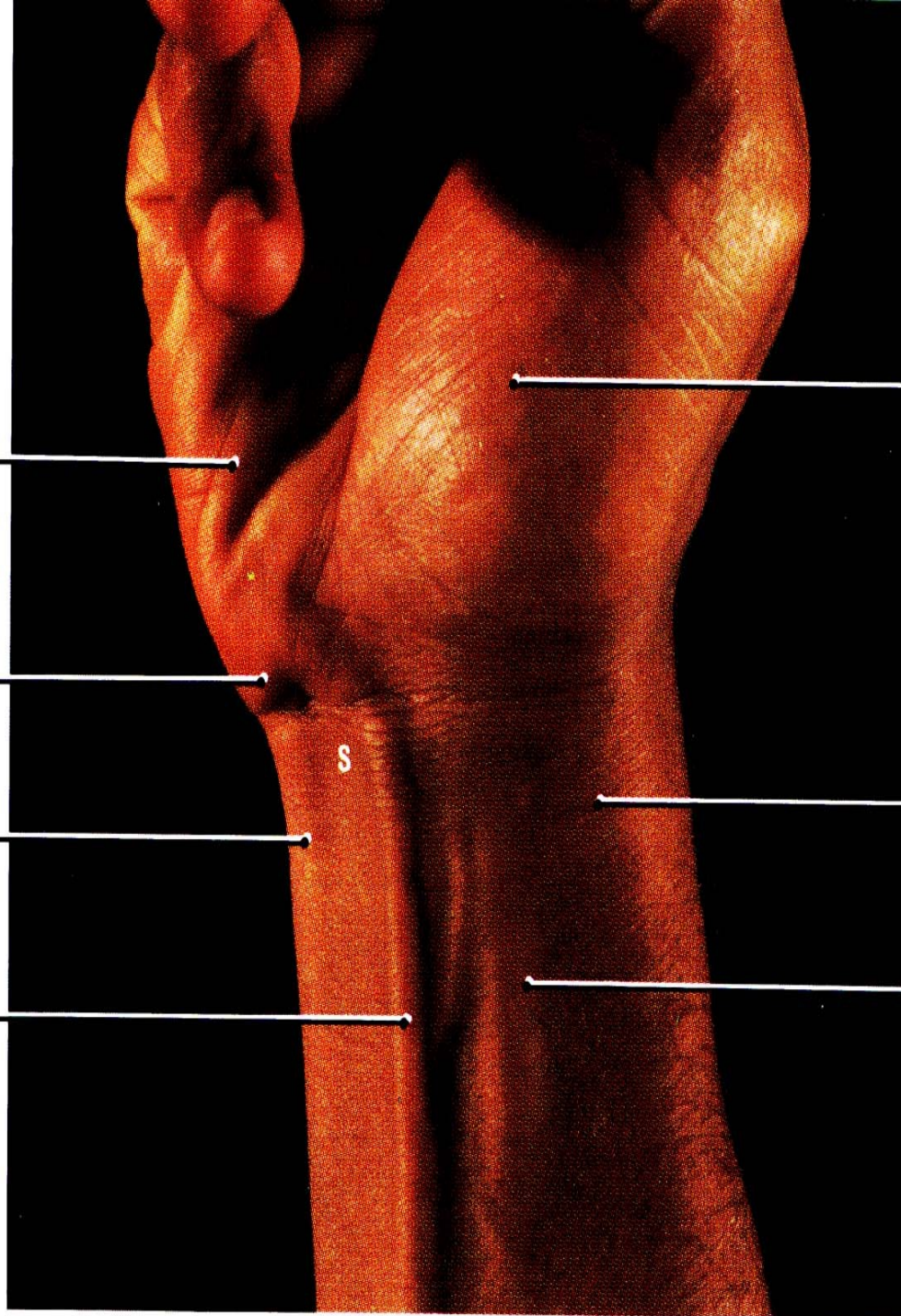


(C)

# Tendon Sheath







Thenar eminence

Hypothenar eminence

Location of pisiform bone

Site for taking radial pulse

Tendon of flexor carpi ulnaris

Tendon of flexor carpi radialis

Tendon of palmaris longus



# **CARPAL TUNNEL**

# CARPAL TUNNEL

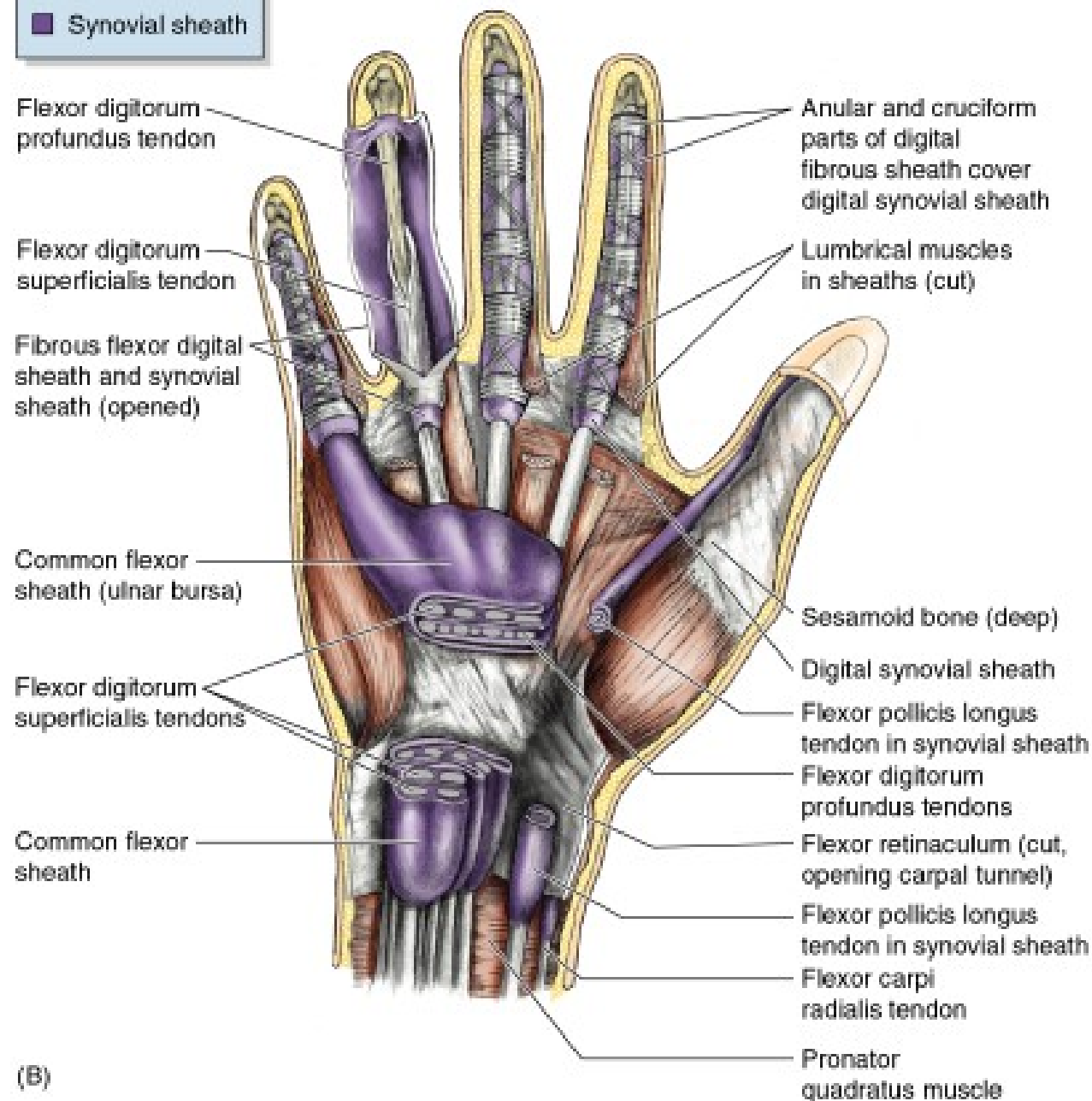
- The carpal bones articulate with each other at synovial *intercarpal joints* & bound together with ligaments into a compact mass.
- **Carpal groove** (sulcus) - anterior concavity
- **Carpal tunnel** - covered by the *flexor retinaculum*

# CARPAL TUNNEL

- The **Median nerve** passes thru this tunnel
- **Carpal Tunnel Syndrome** - caused compression of the median nerve.

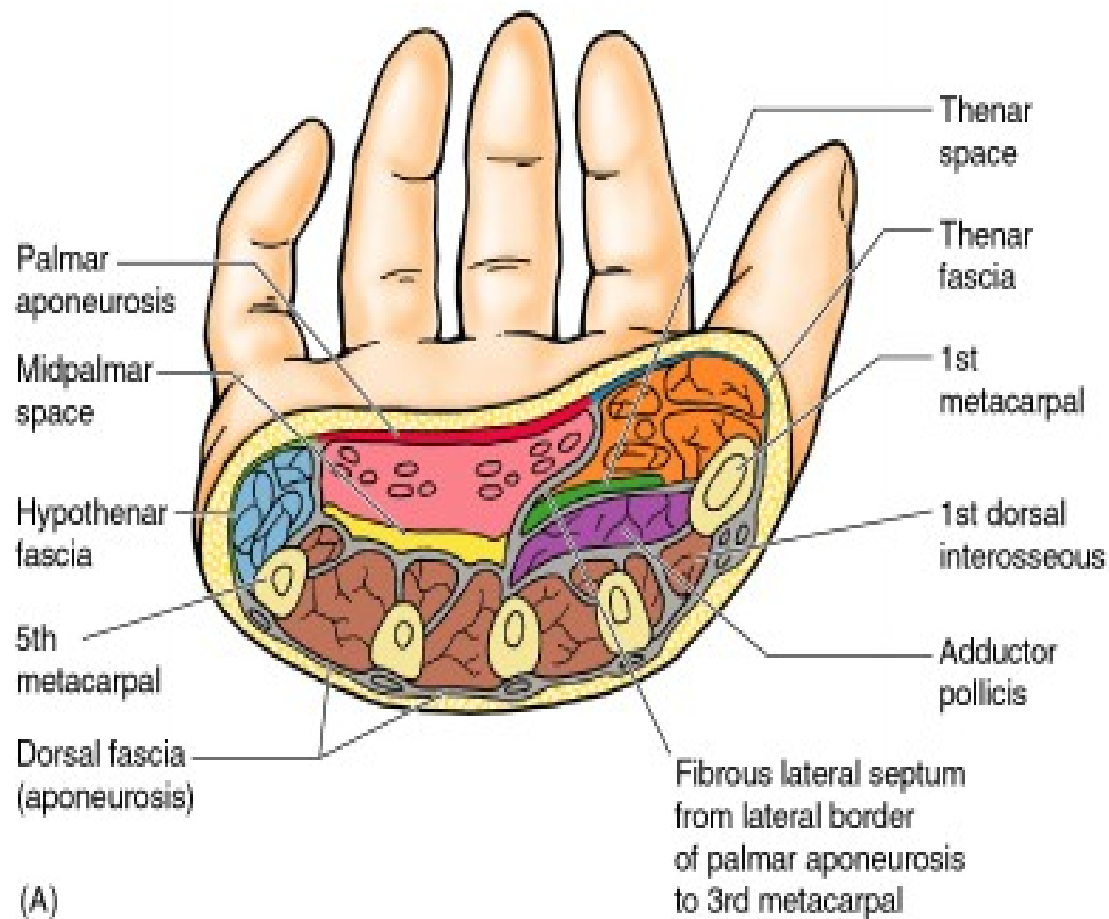
Key

■ Synovial sheath

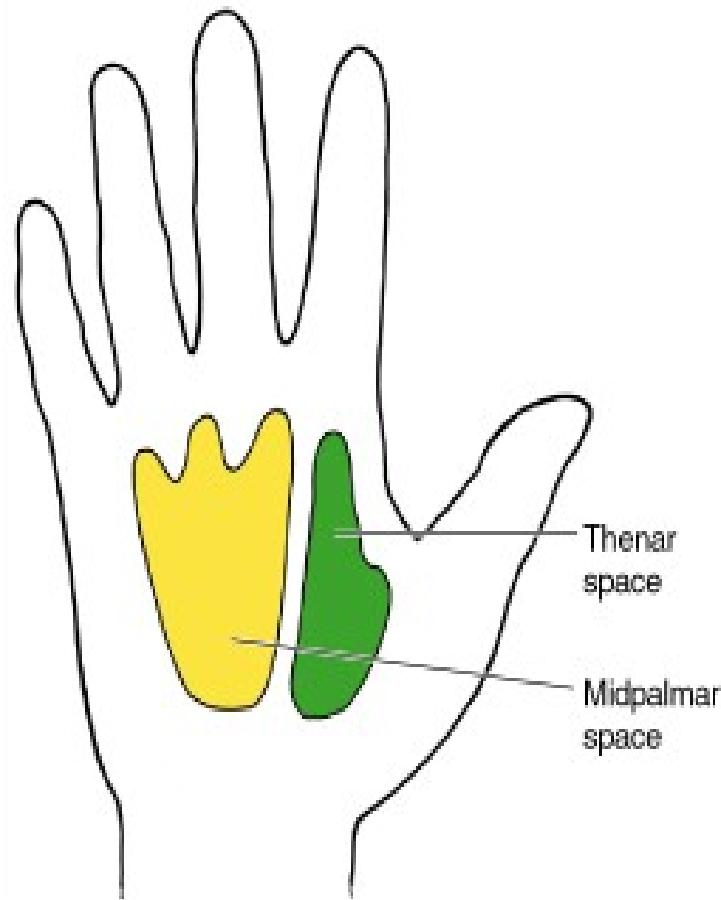


(B)

6.54A, B. Compartments, spaces, and fascia of the palm.



(A)



(B)

Key

- Hypothenar compartment
- Thenar compartment
- Central compartment
- Adductor compartment

**Flexor pollicis  
longus m.,  
tendon &  
sheath**

**Median n.**

**Ulnar v. a. n.**

**Flexor retinaculum**

**Trapezium**

**Flexor carpi  
radialis m.,  
tendon &  
sheath**

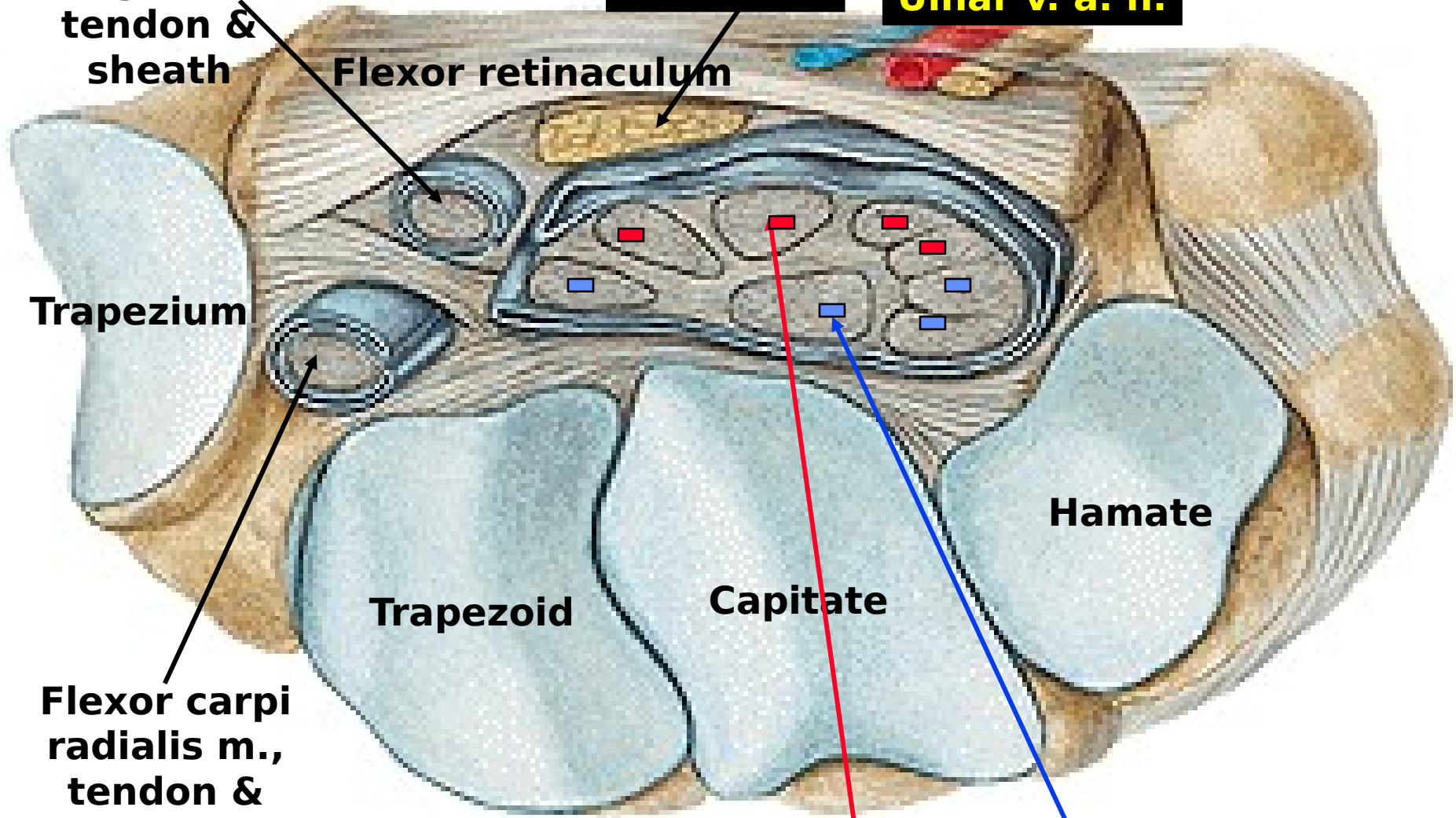
**Hamate**

**Trapezoid**

**Capitate**

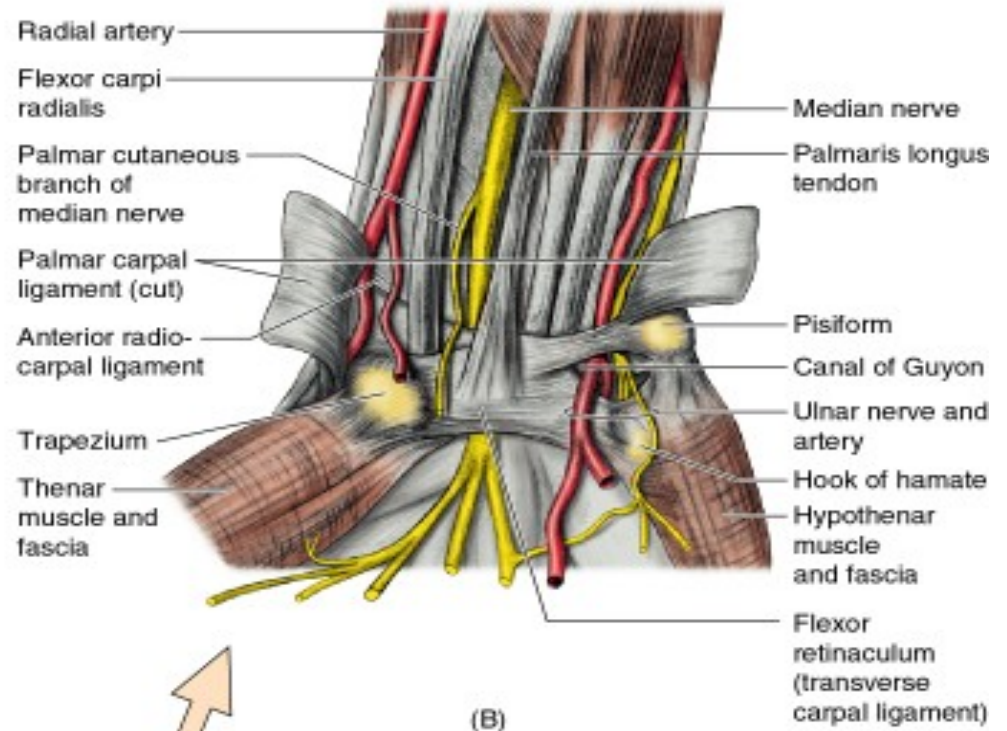
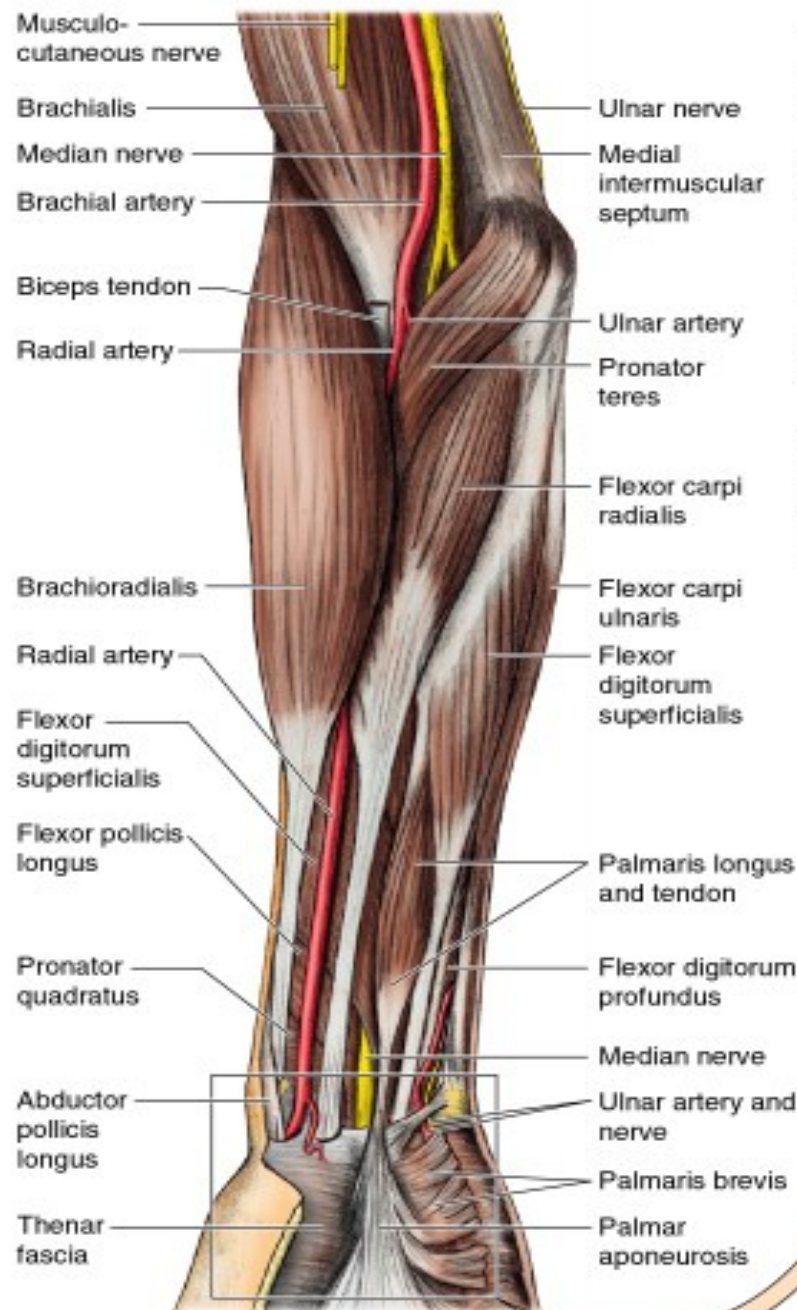
**Flexor digitorum superficialis & profundus m., ter**

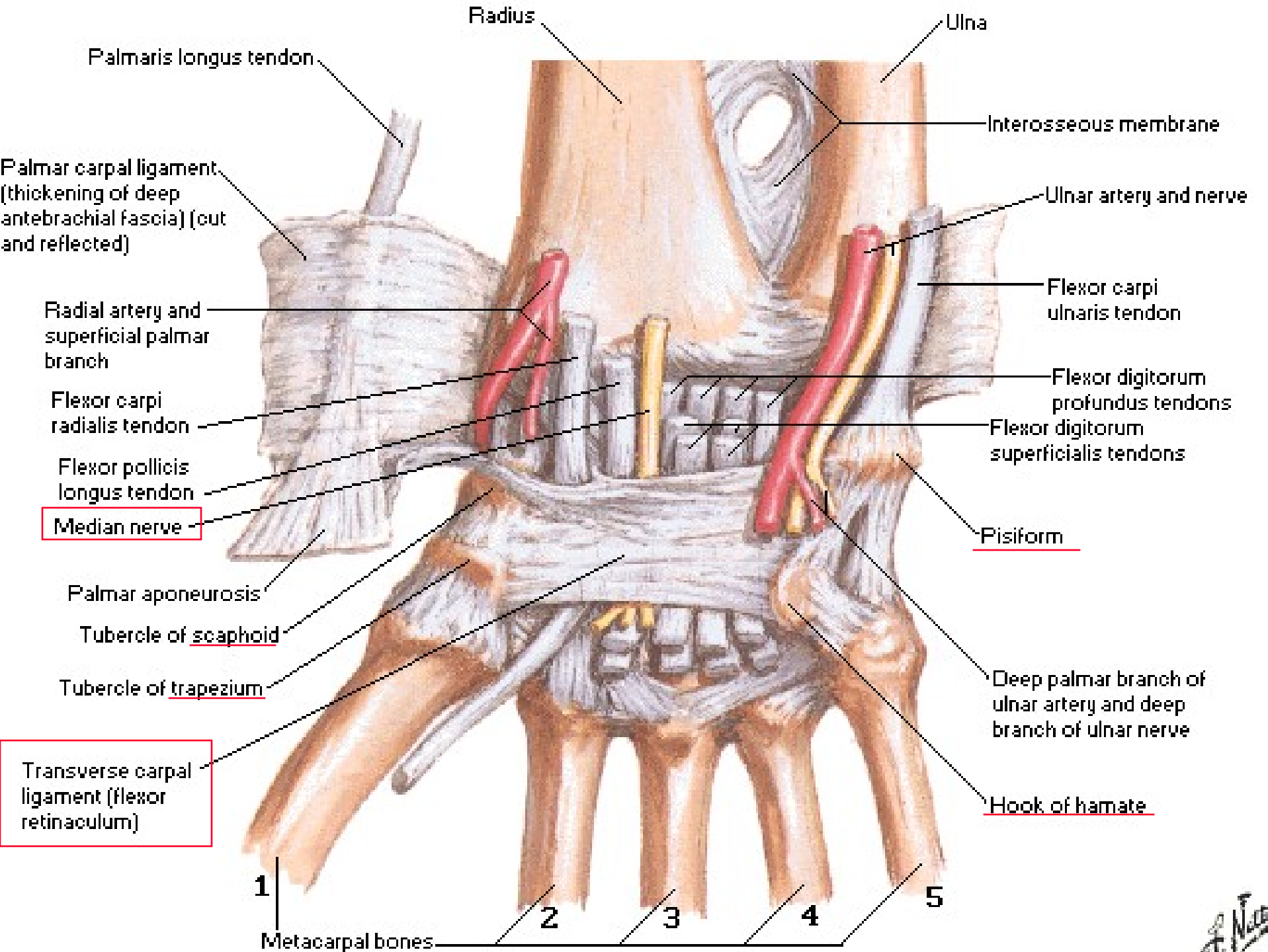
**Rt. Palmar Carpal Sheaths @ the Carpometacarpal Joints**



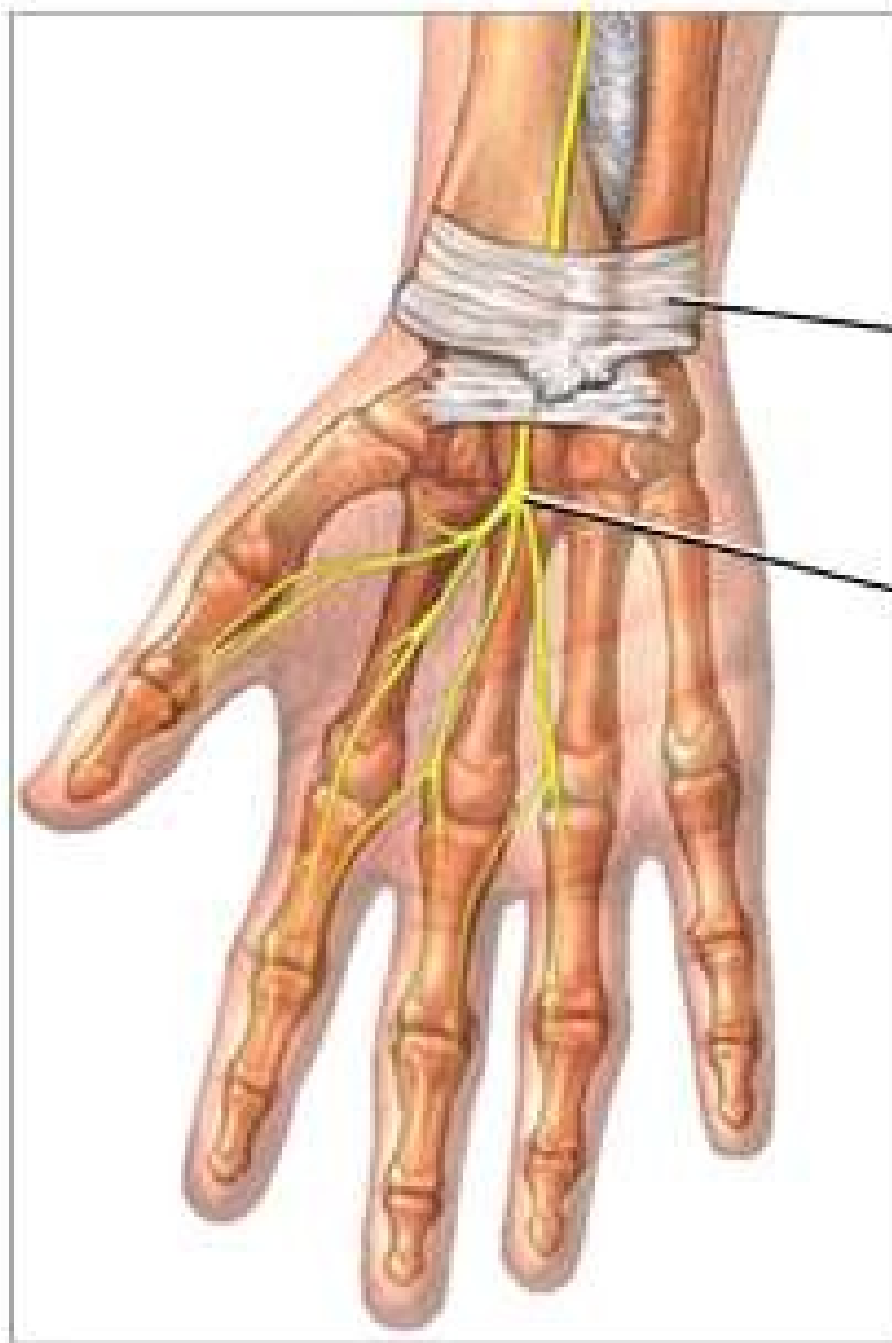


6.51A, B. Neurovascular structure in the anterior aspect of the forearm and wrist.



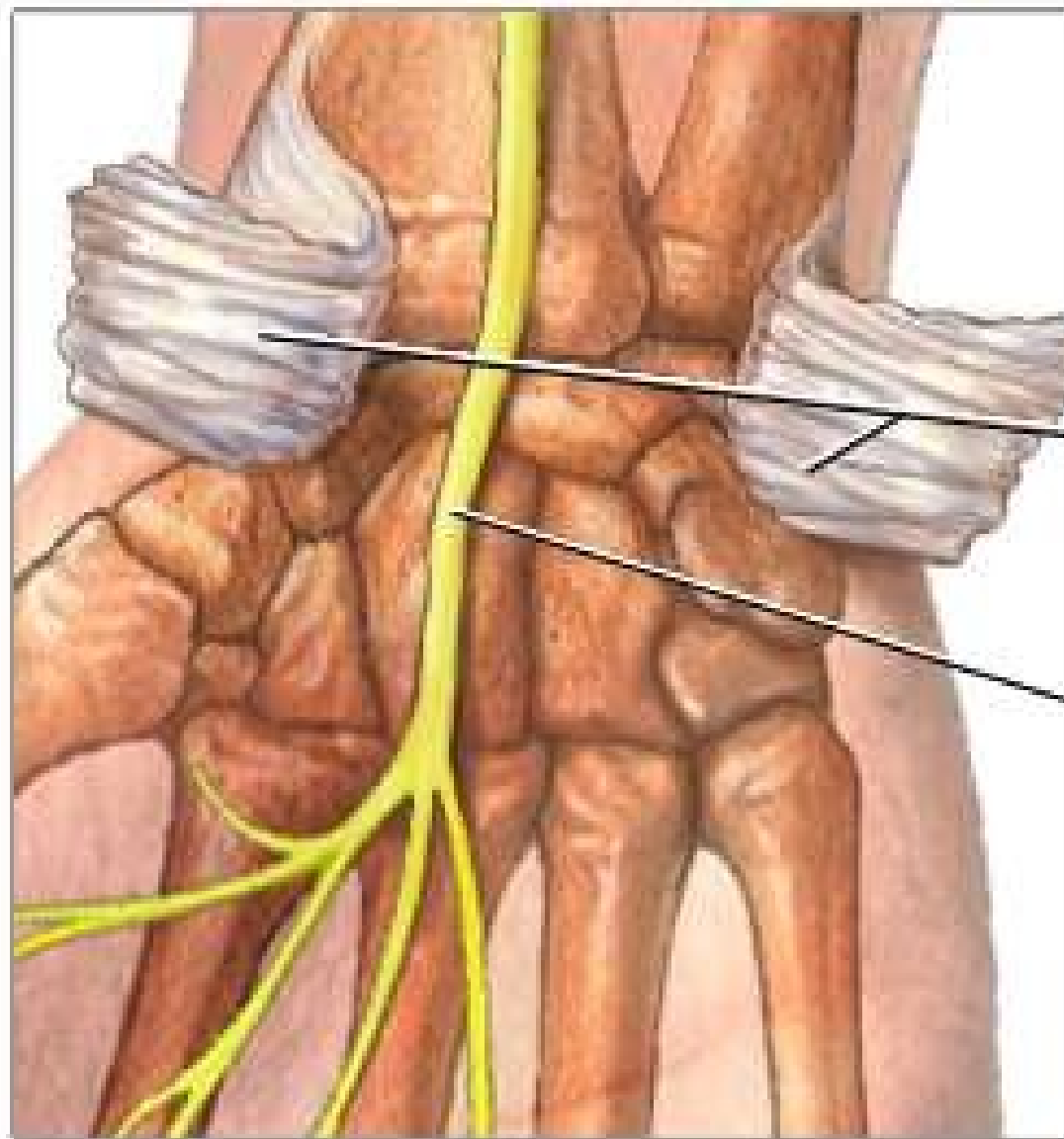






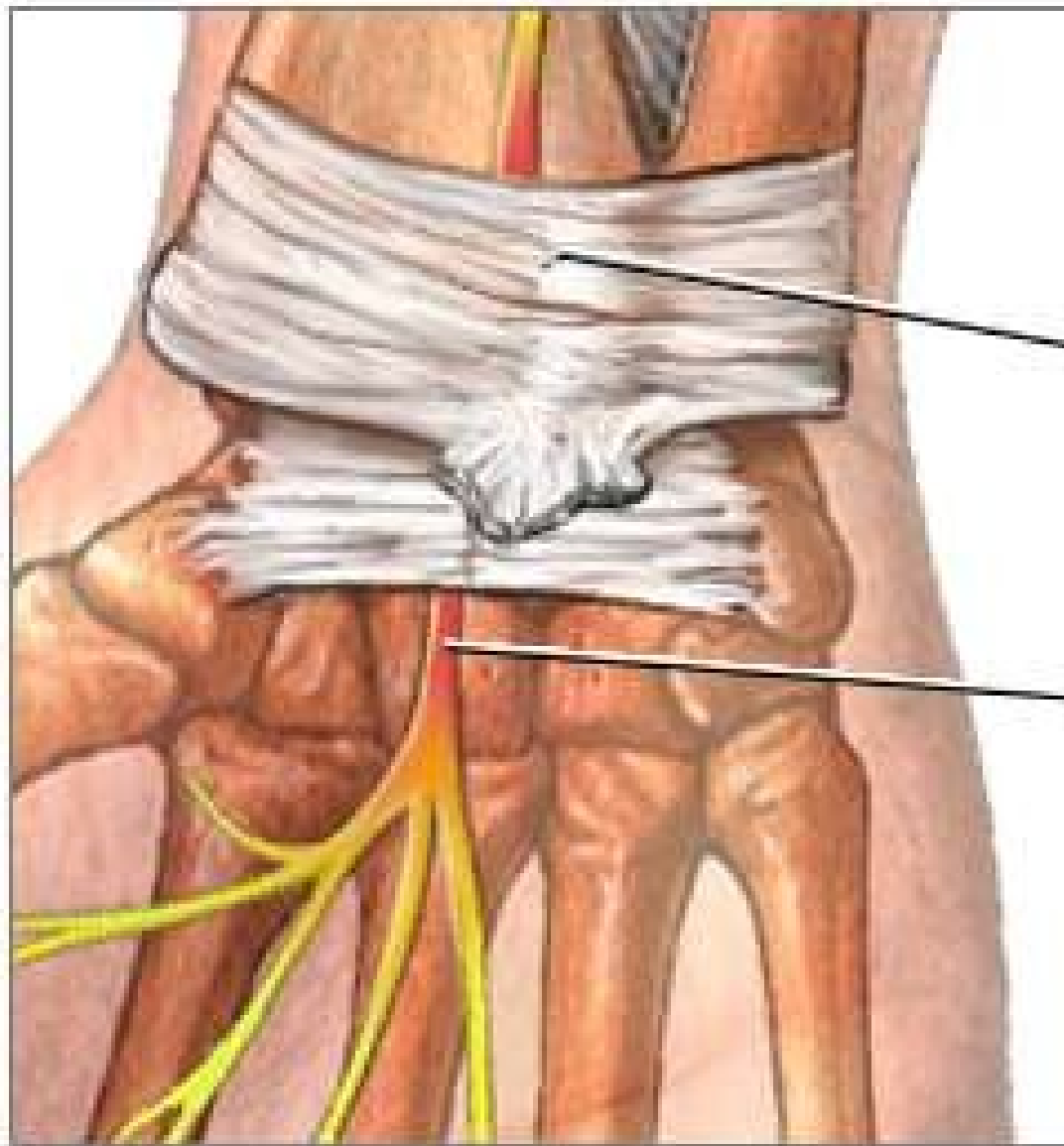
Palmar carpal  
ligament

Median nerve



Carpal ligament  
(cut)

Median nerve

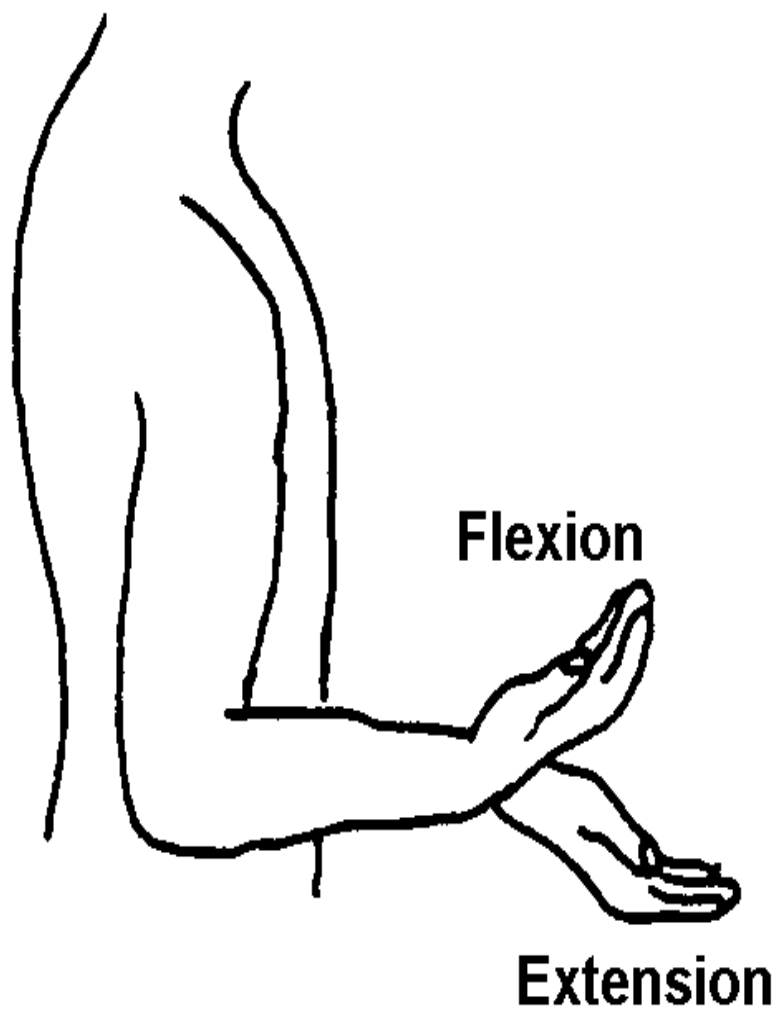


Constriction at  
carpal ligament

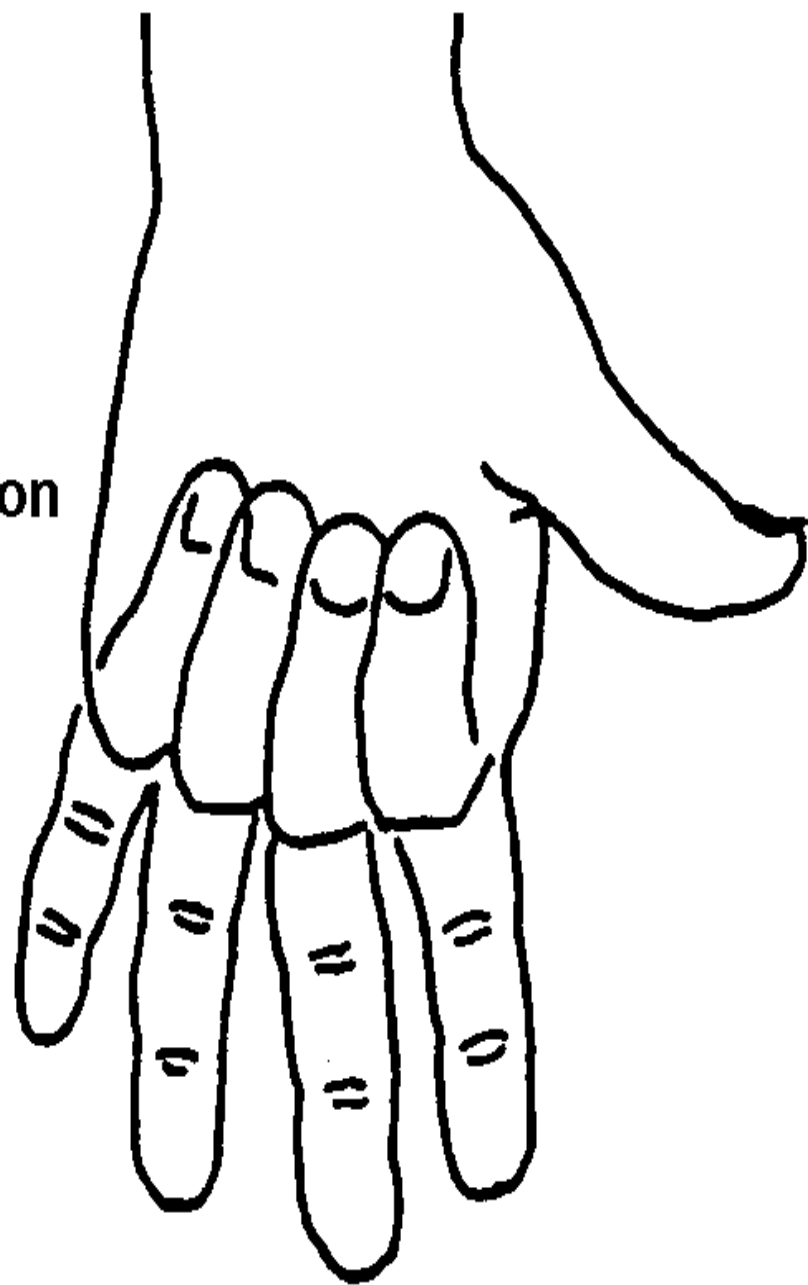
Inflammation of  
median nerve



# **MOVEMENTS of the WRIST and HAND**

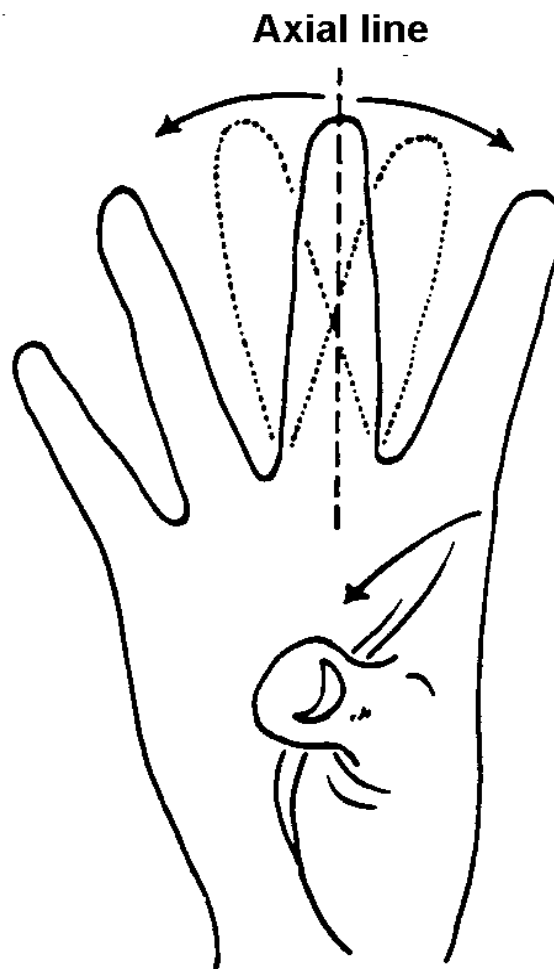


**Flexion**

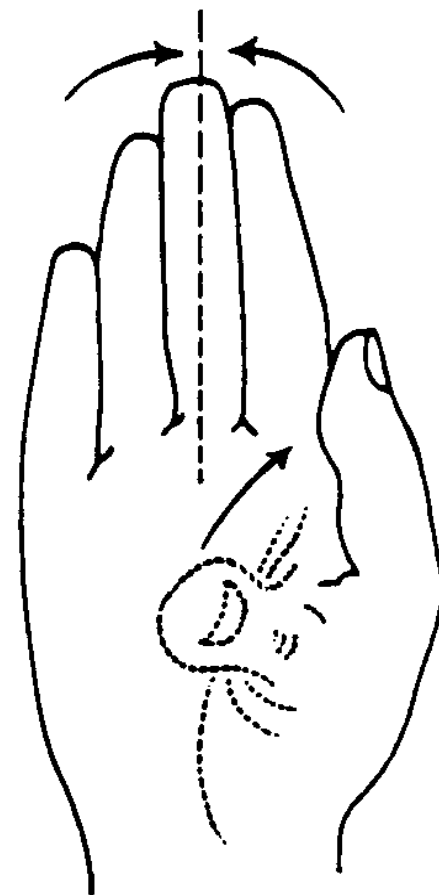




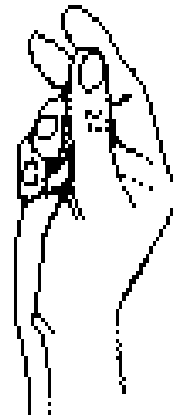
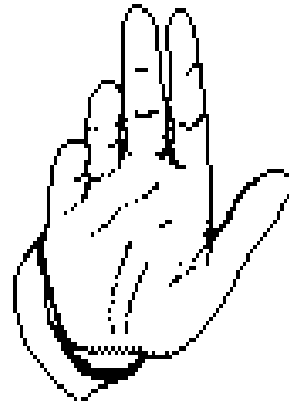
**Opposition**



**Abduction**

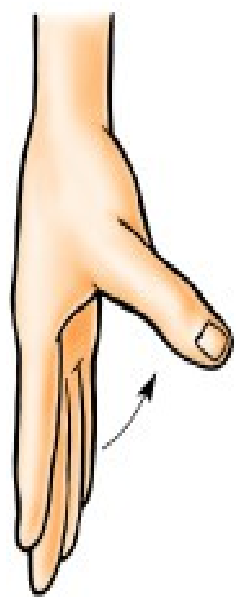


**Adduction**



**OPPOSIBILITY & GRIPING**

6.56. Movements of the thumb.



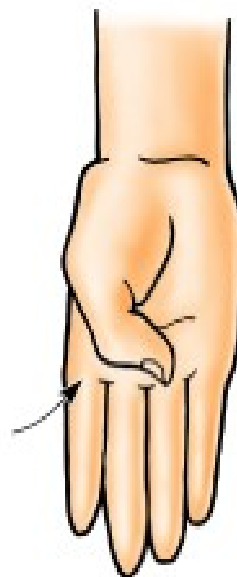
Abduction



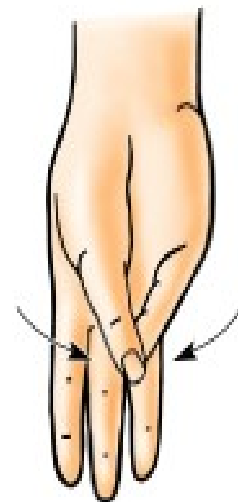
Adduction



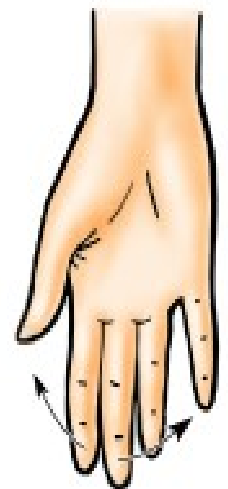
Extension



Flexion

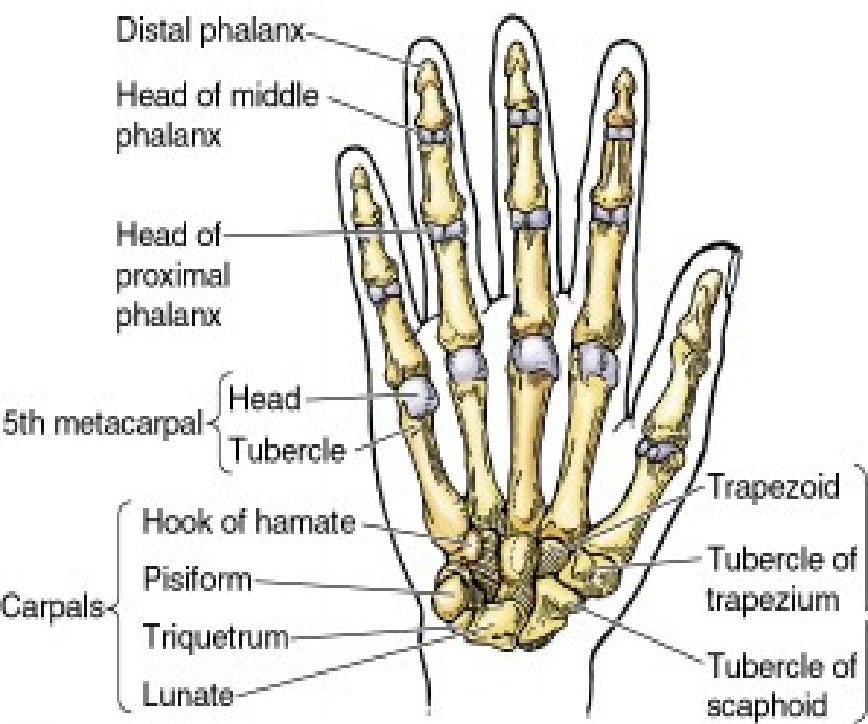


Opposition

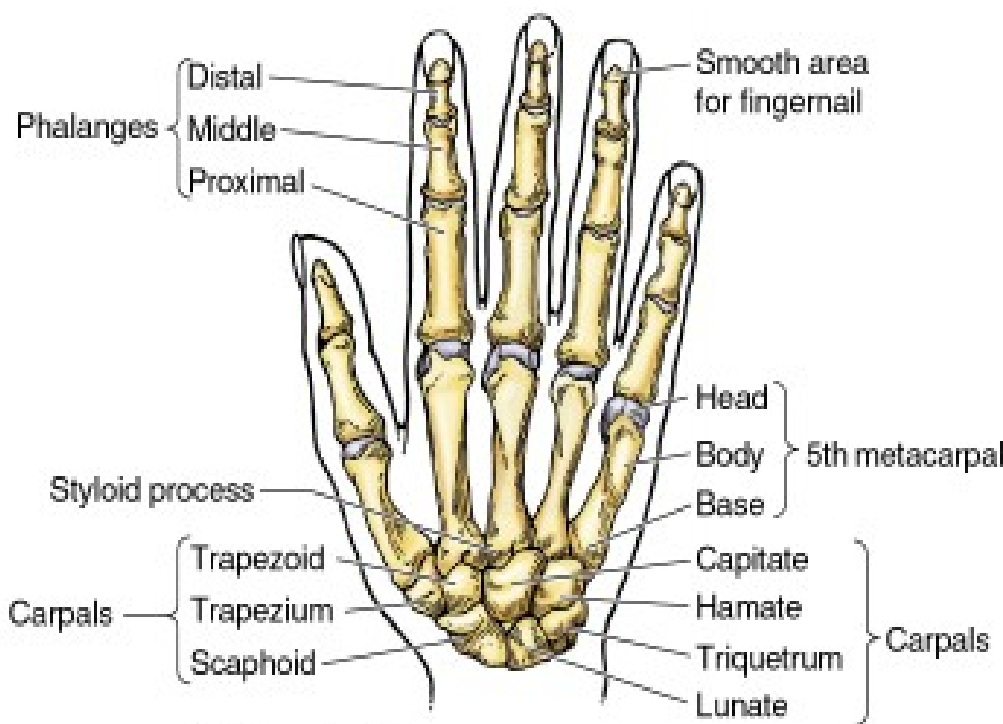


Reposition

6.8A, B. Bones of the right hand.



(A) Anterior view



(B) Posterior view



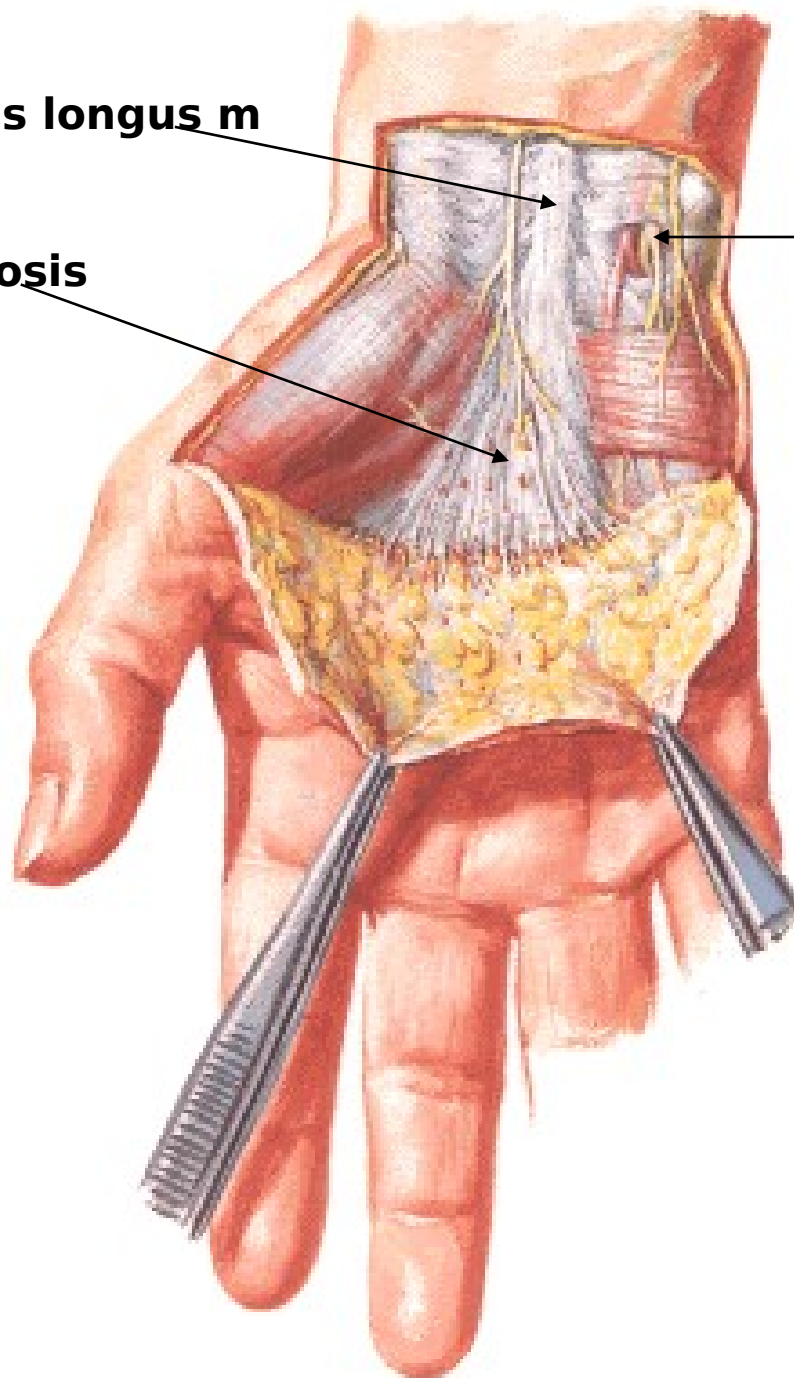


# **TENDONS and LIGAMENTS OF THE HAND**

**Tendon, palmaris longus m**

**Palmar aponeurosis**

Ulnar a. & n.



## Lt. Palm Muscles

Palmaris longus m., tendon

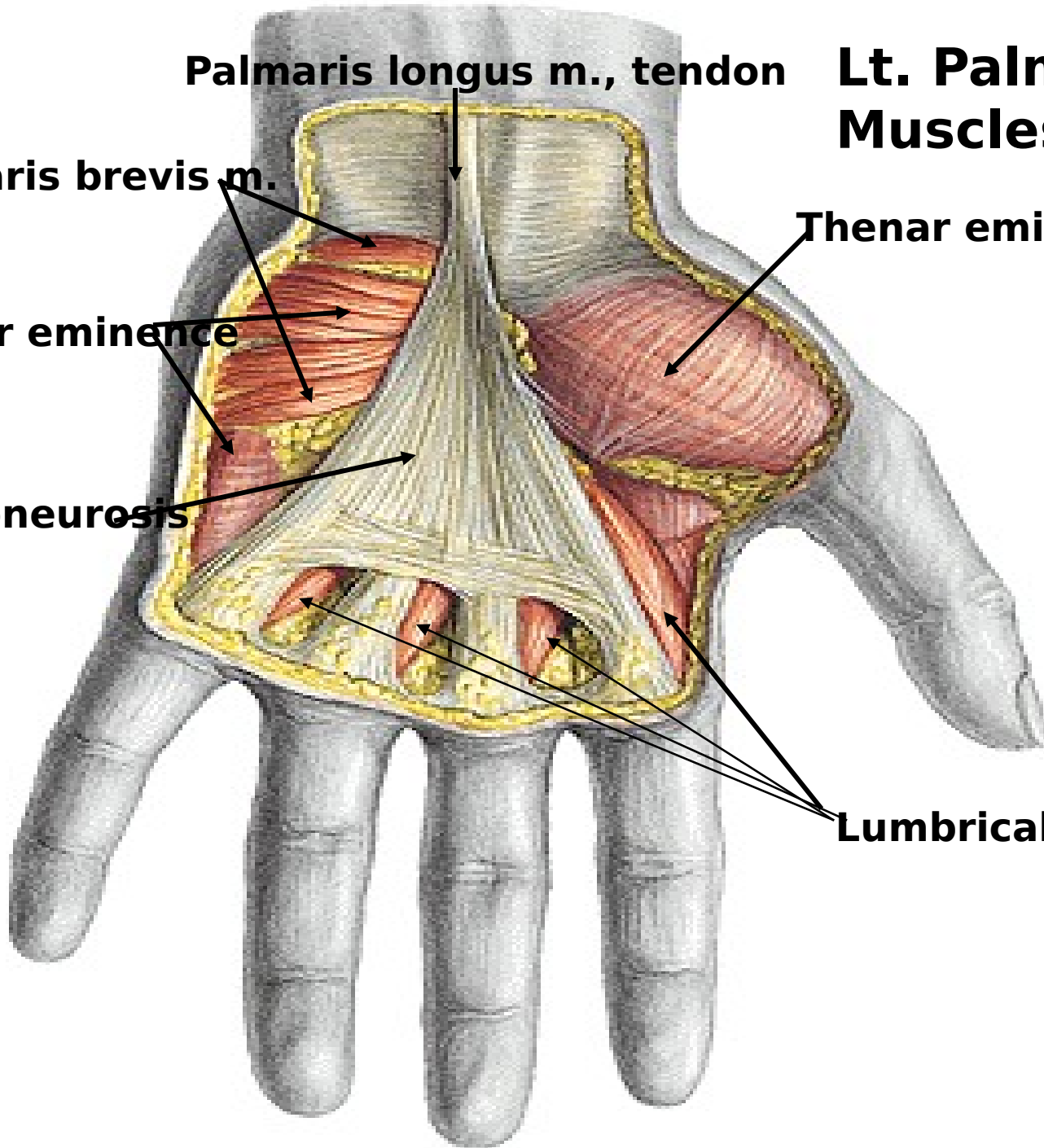
Palmaris brevis m.

Thenar eminence

Hypothenar eminence

Palmar aponeurosis

Lumbrical mm.



# Lt. Palm Tendon Sheaths & Muscles

**Flexor retinaculum**

**Abductor digiti minimi m.**

**Flexor digiti  
minimi brevis  
m.**

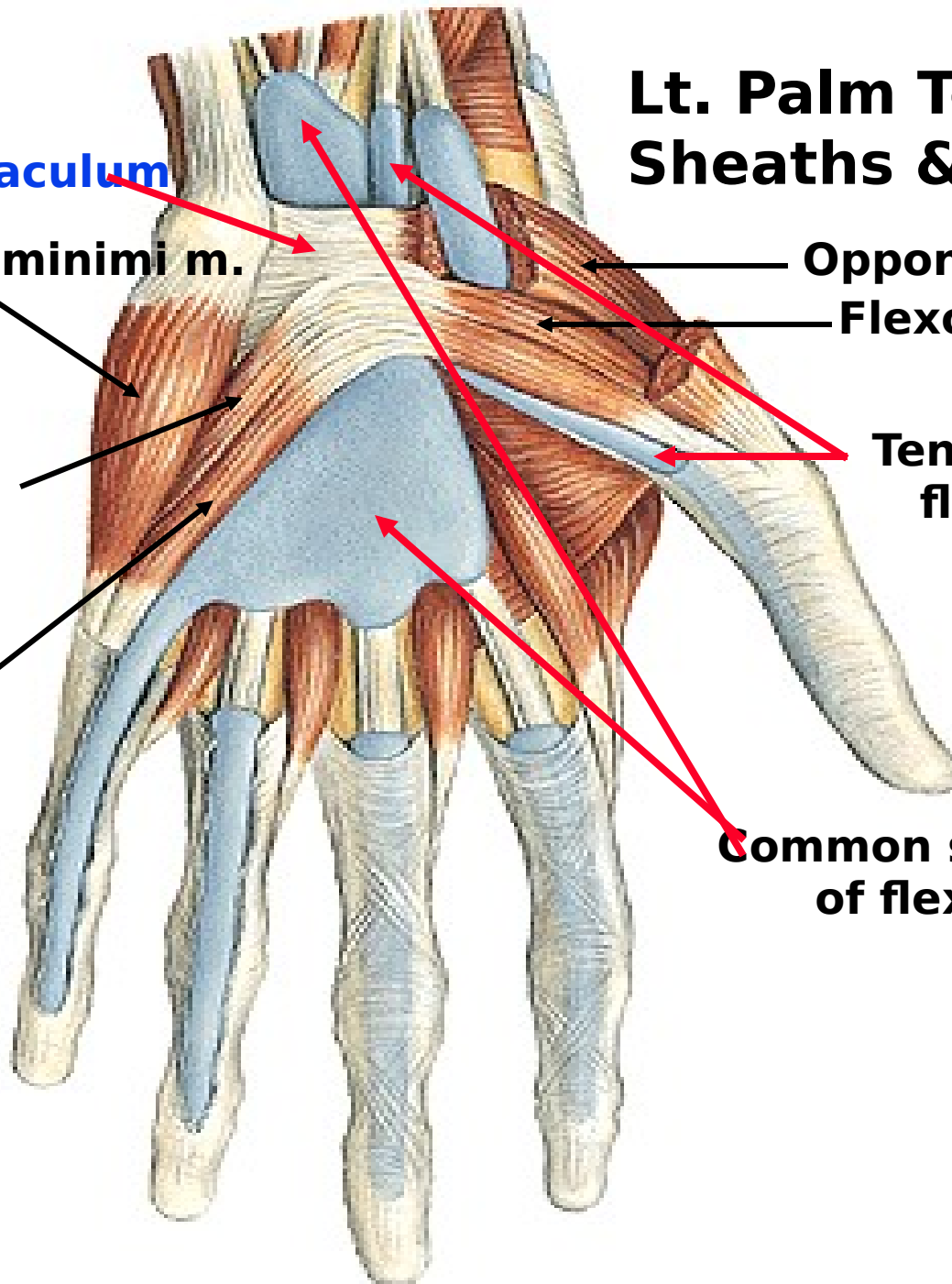
**Opponens  
digiti minimi  
m.**

**Opponens pollicis m.**

**Flexor pollicis brevis**

**Tendon sheath of  
flexor pollicis  
longus m.**

**Common synovial sheath  
of flexor tendons**



**Radial a**

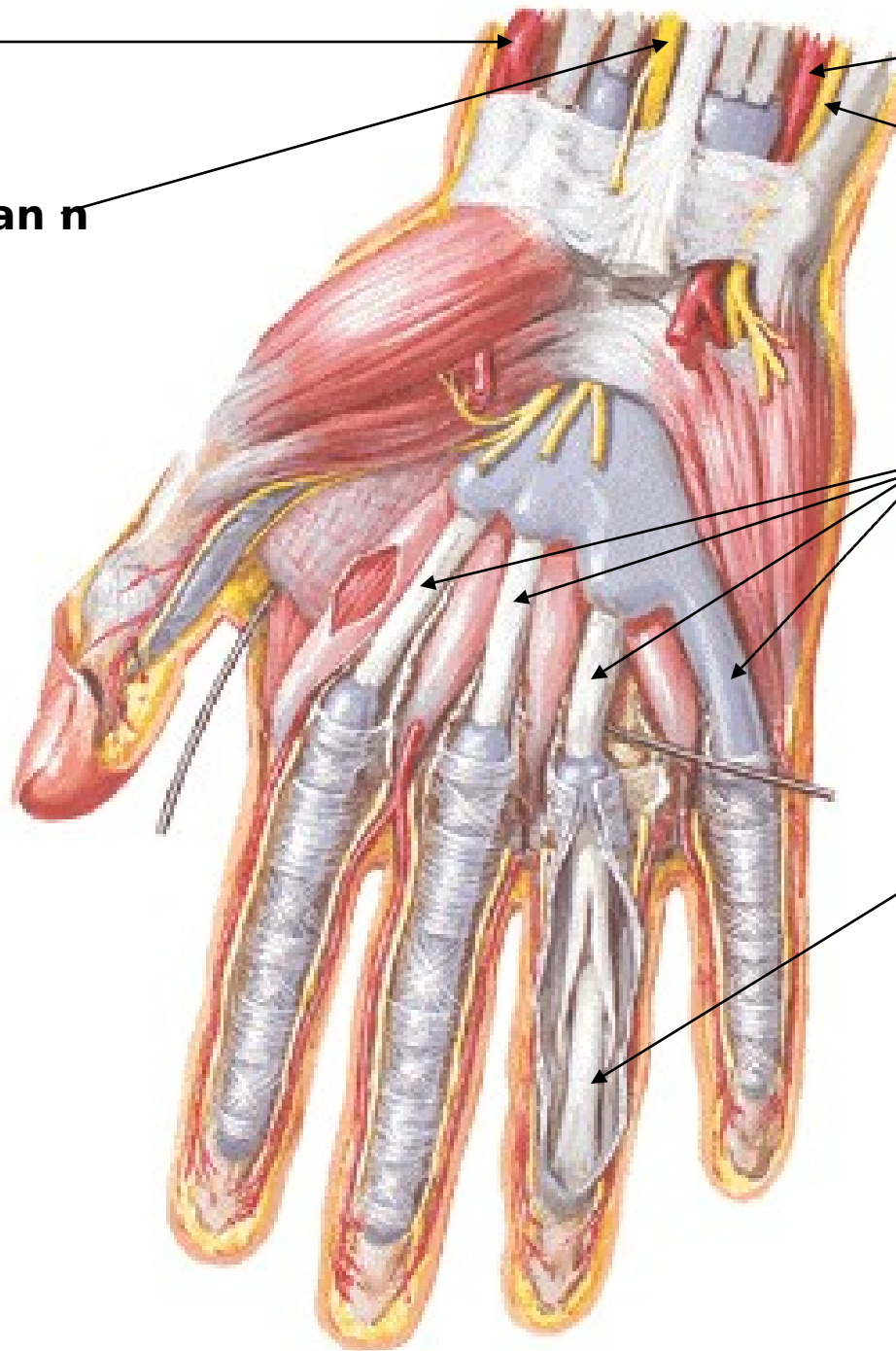
**Ulnar a**

**Median n**

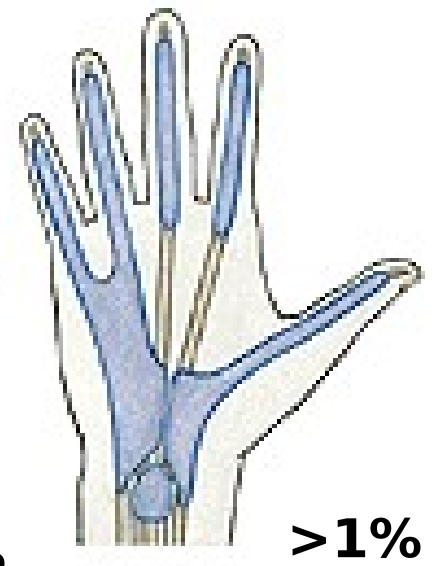
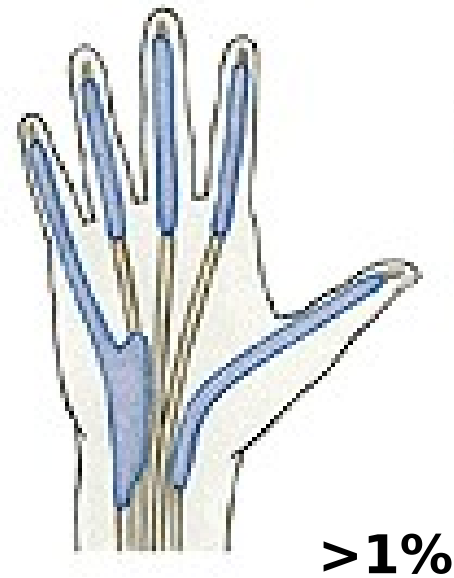
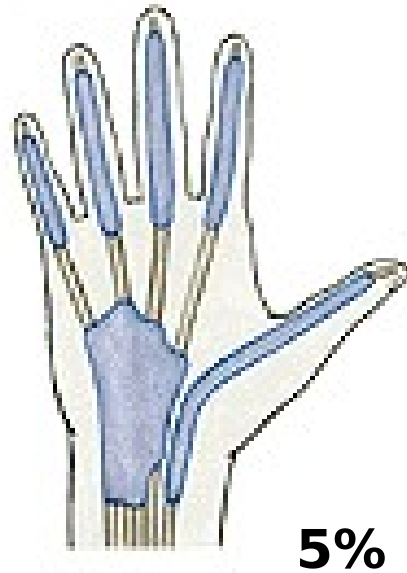
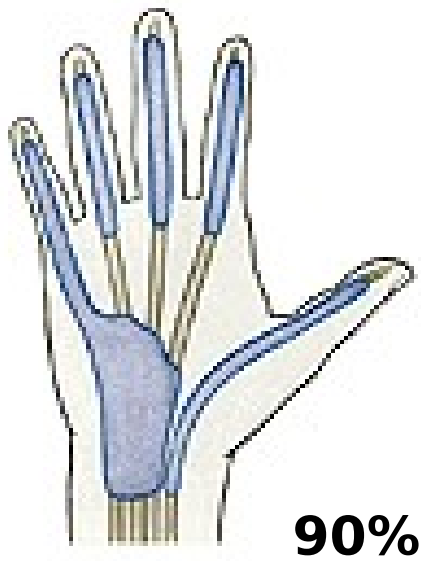
**Ulnar n**

**Tendons of FDS**

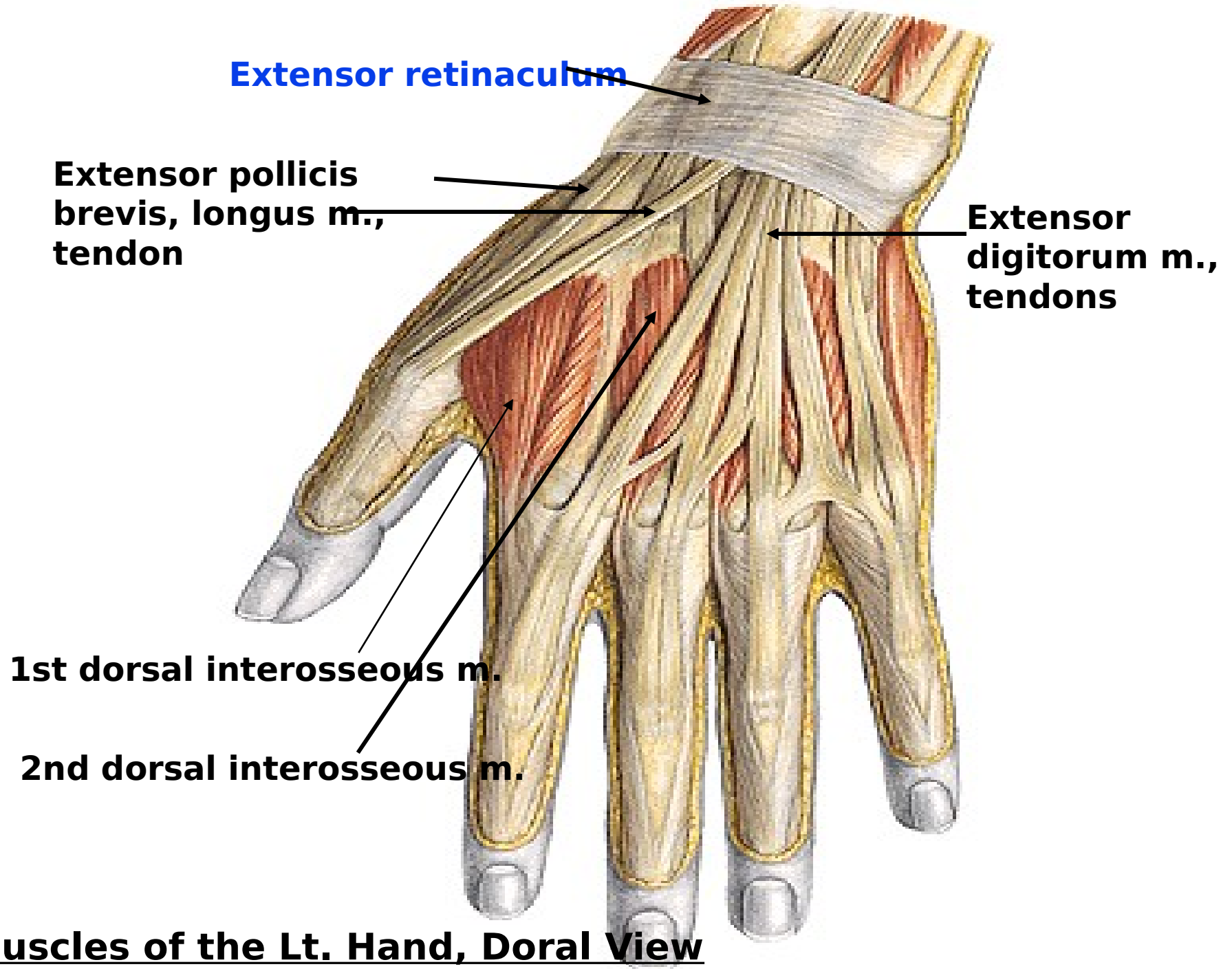
**Tendon of FDP**



# Frequency Variation of Palmar Tendon Sheaths





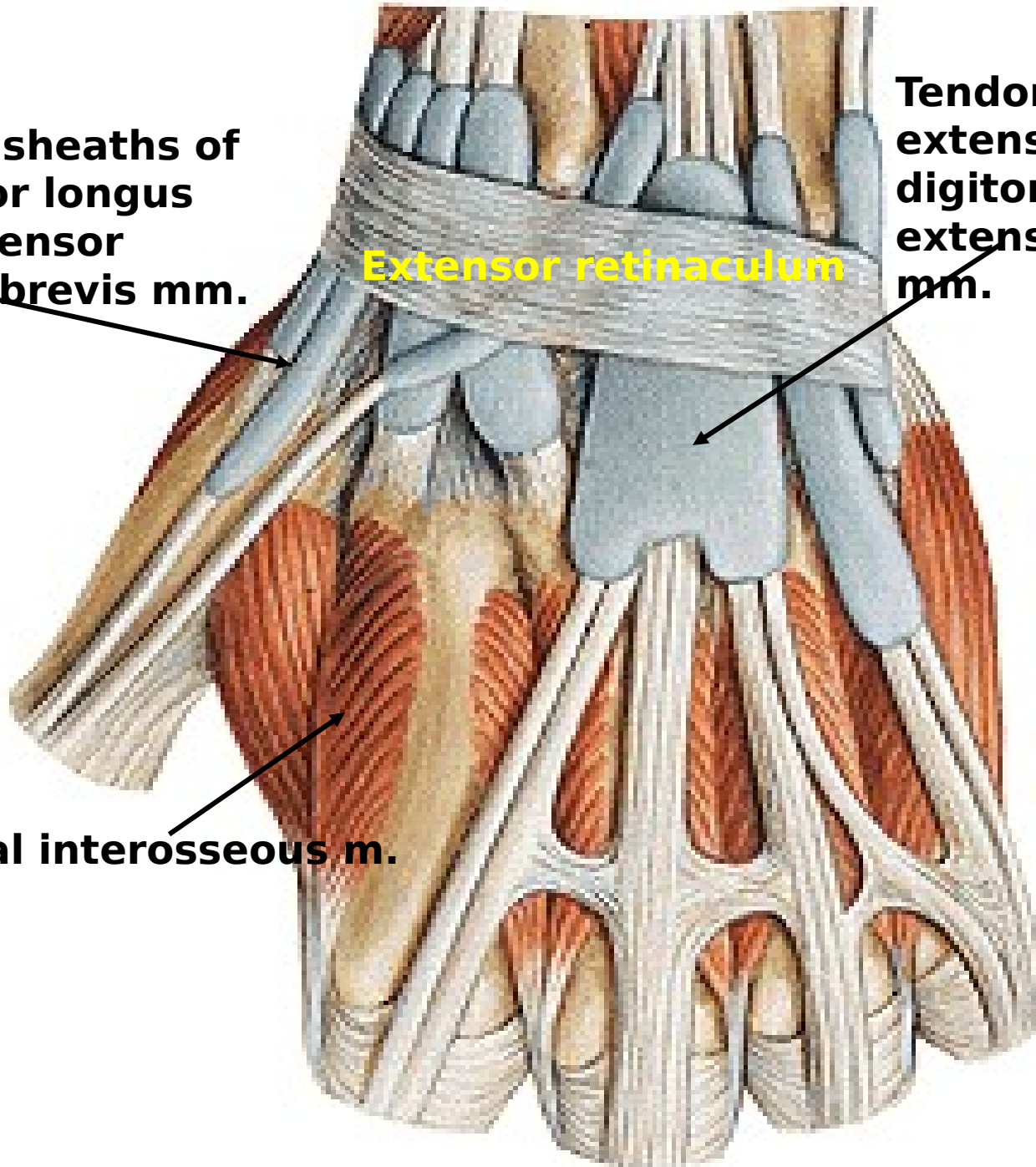


**Tendon sheaths of  
abductor longus  
and extensor  
pollicis brevis mm.**

**Extensor retinaculum**

**Tendon sheaths of  
extensor  
digitorum and  
extensor indicis  
mm.**

**1st dorsal interosseous m.**



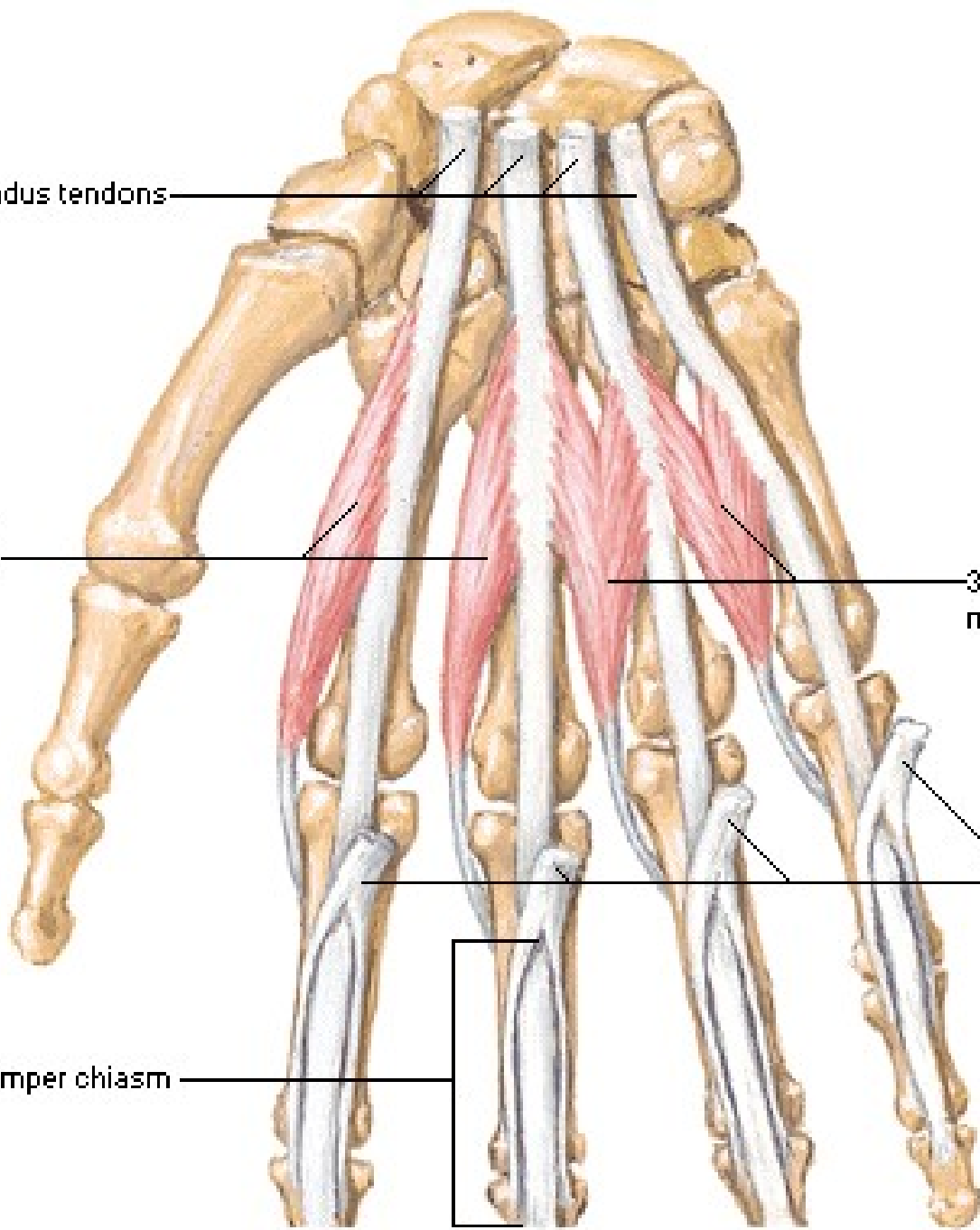
Flexor digitorum profundus tendons

1st and 2nd lumbrical muscles (unipennate)

3rd and 4th lumbrical muscles (bipennate)

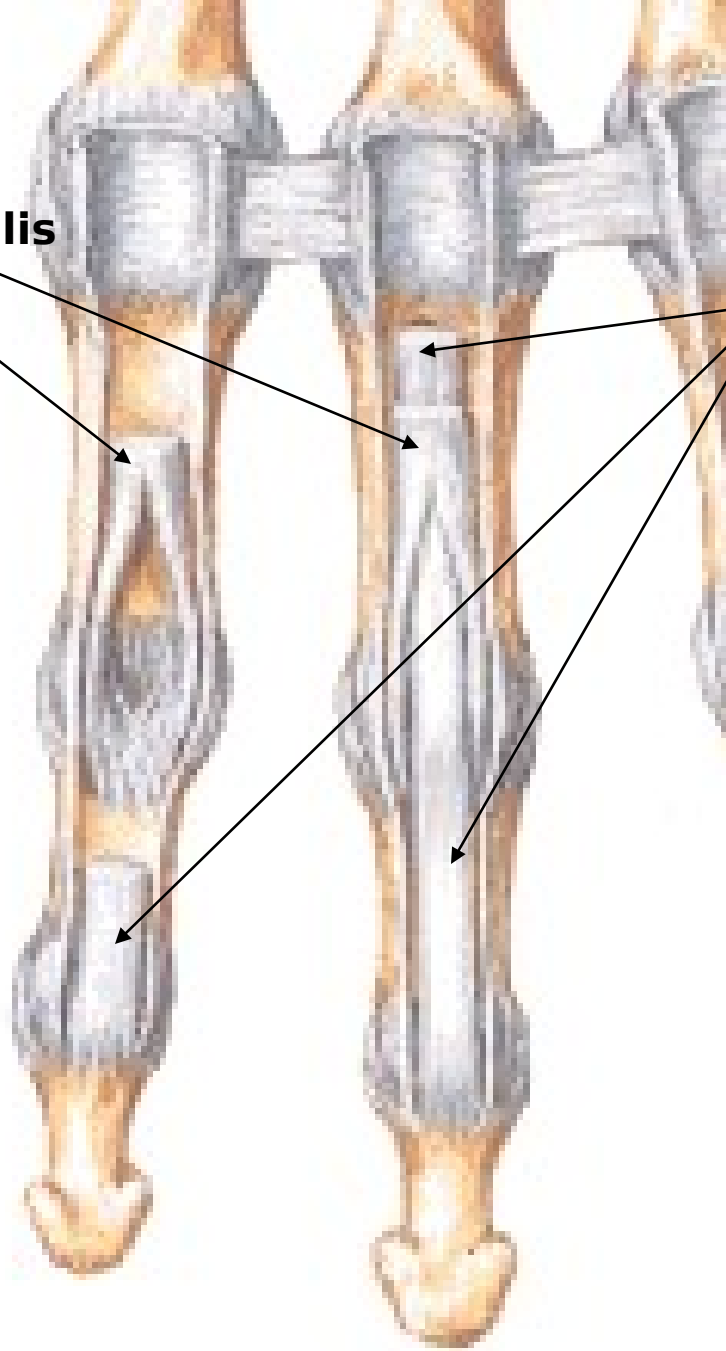
Flexor digitorum superficialis tendons (cut)

Camper chiasm

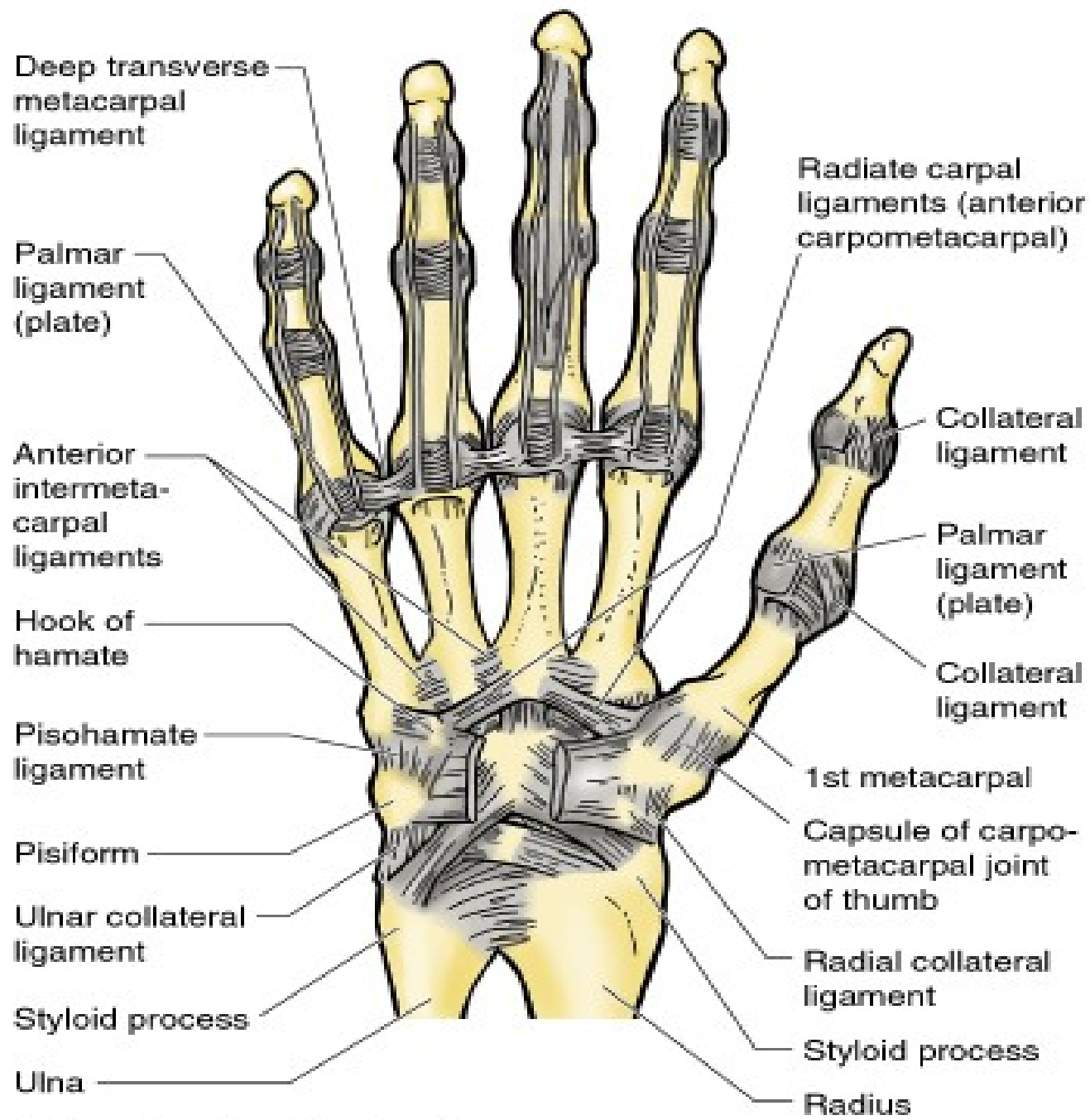


**Tendon, Flexor  
Digitorum Superficialis**

**Tendon, Flexor  
Digitorum  
Profundus**



6.77A, C. Joints of the carpus and digits.



**Flexor pollicis  
longus m.,  
tendon &  
sheath**

**Median n.**

**Ulnar v. a. n.**

**Flexor retinaculum**

**Trapezium**

**Flexor carpi  
radialis m.,  
tendon &  
sheath**

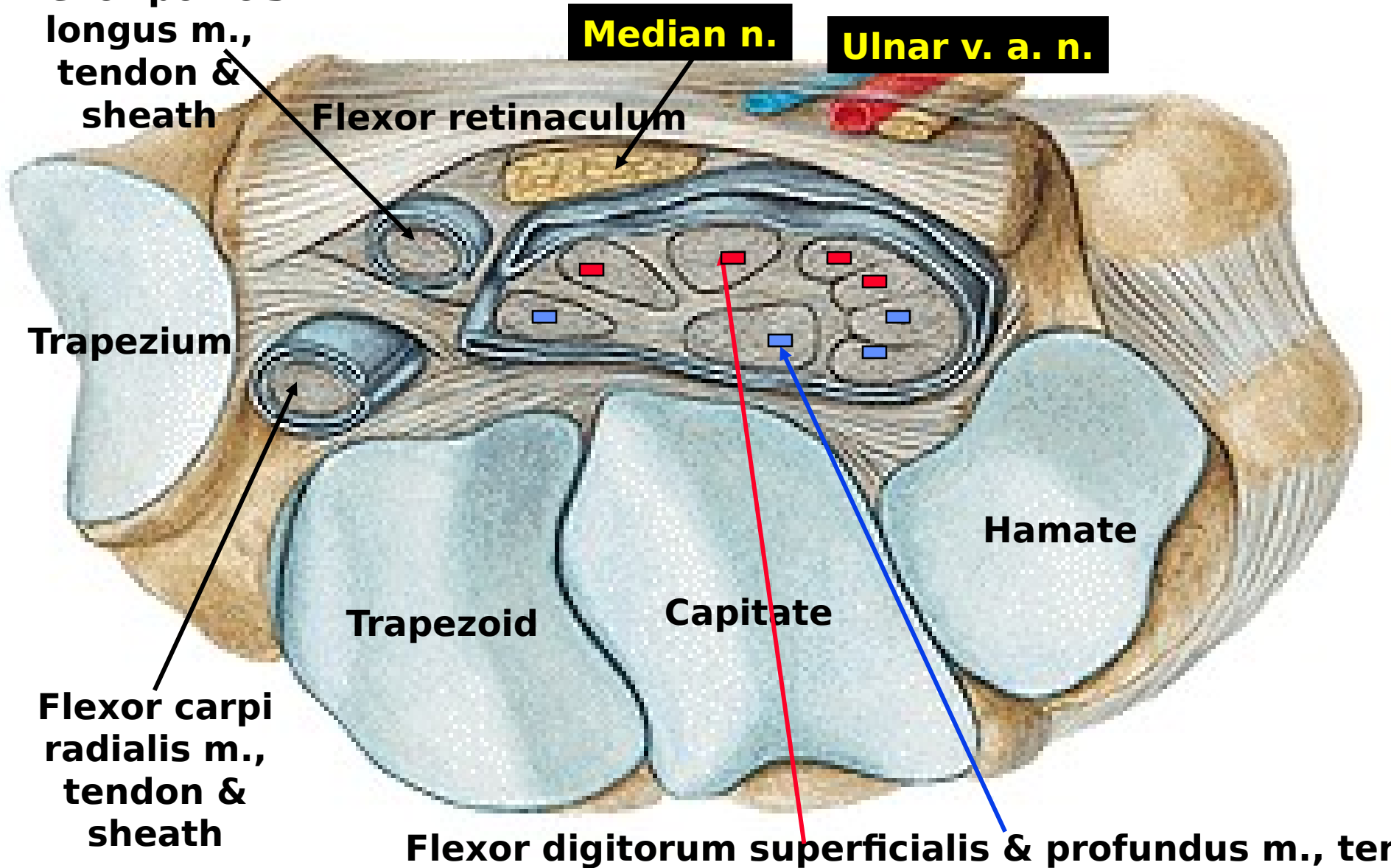
**Hamate**

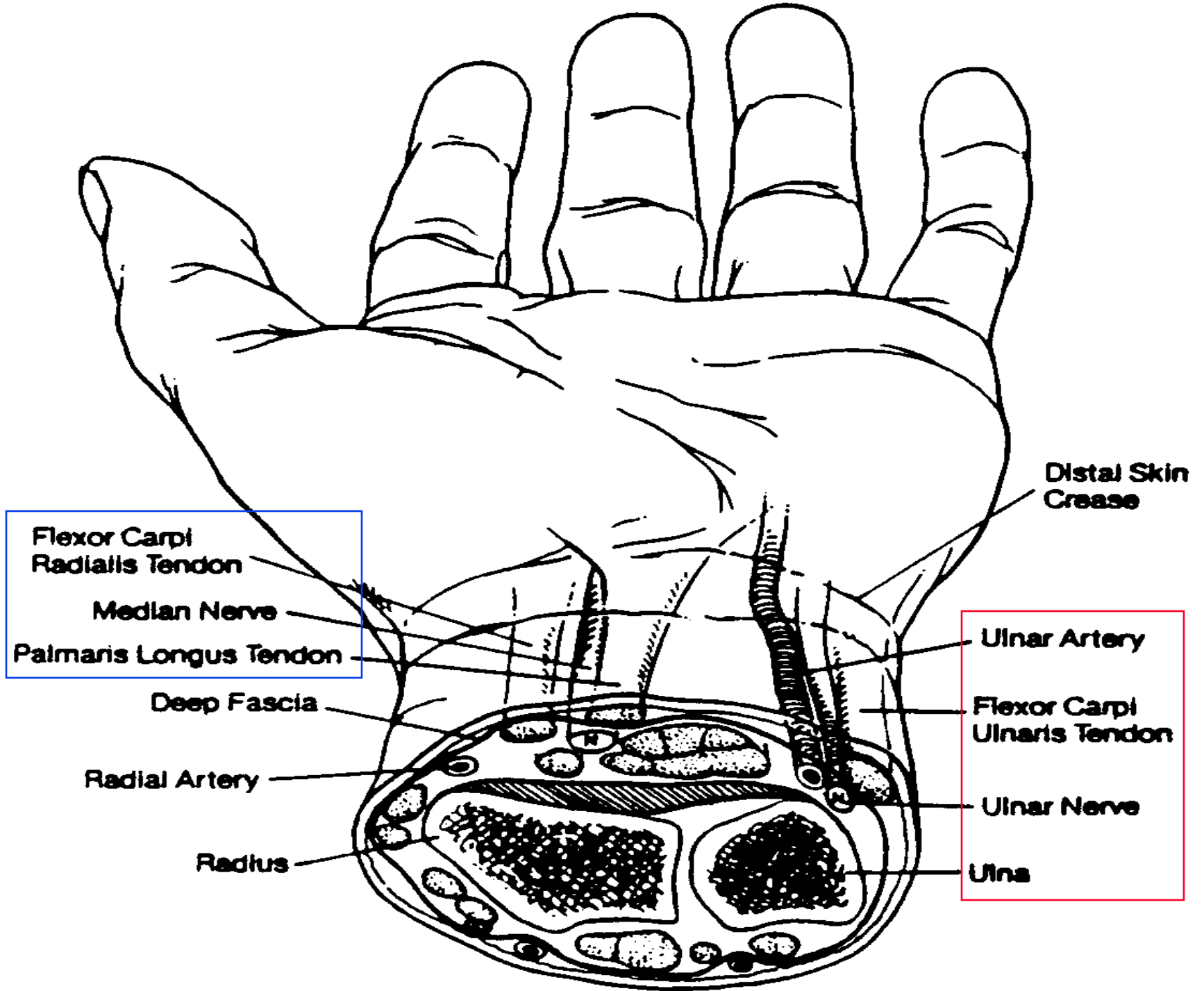
**Trapezoid**

**Capitate**

**Flexor digitorum superficialis & profundus m., ter**

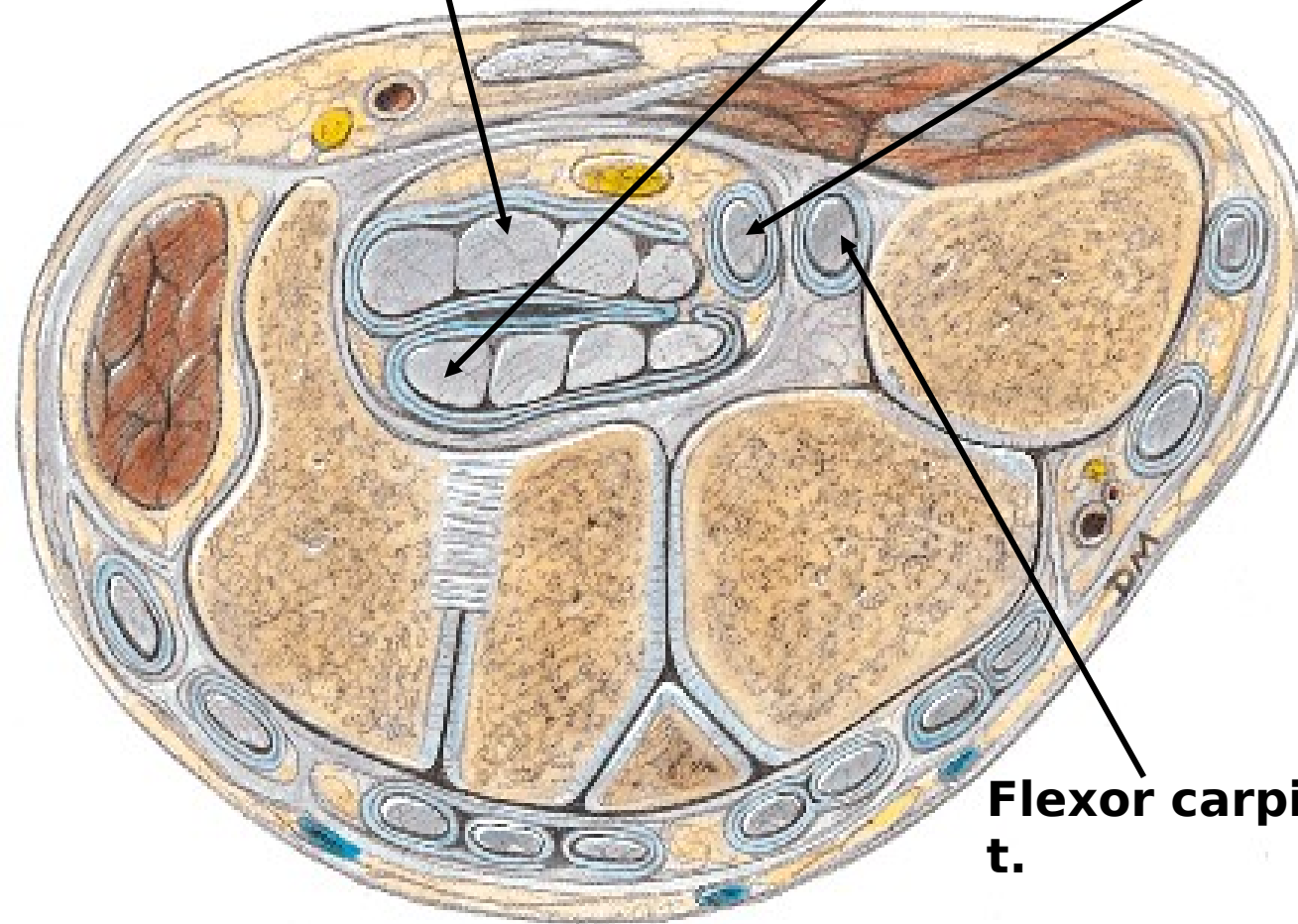
**Rt. Palmar Carpal Sheaths @ the Carpometacarpal Joints**



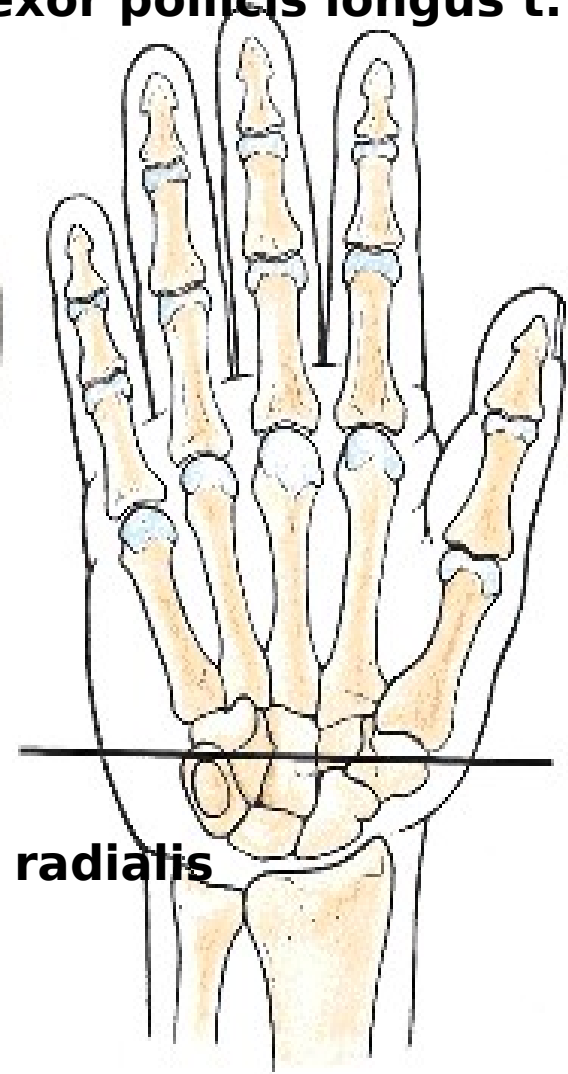




**Flexor digitorum superficialis t.**  
**Flexor digitorum profundus t.**  
**Flexor pollicis longus t.**

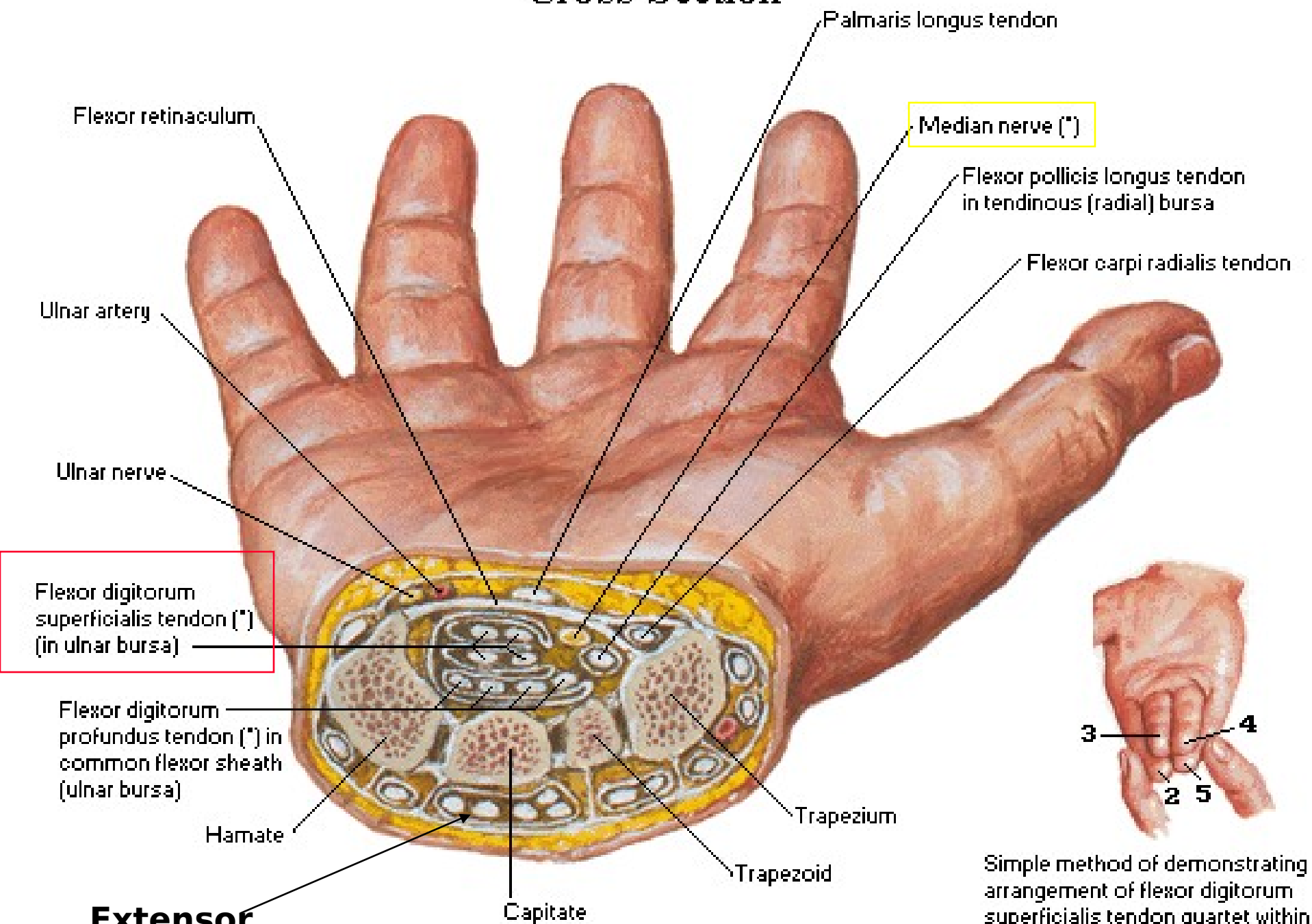


**Flexor carpi radialis t.**



**Lt. Wrist & Hand, Palm**

# Cross Section



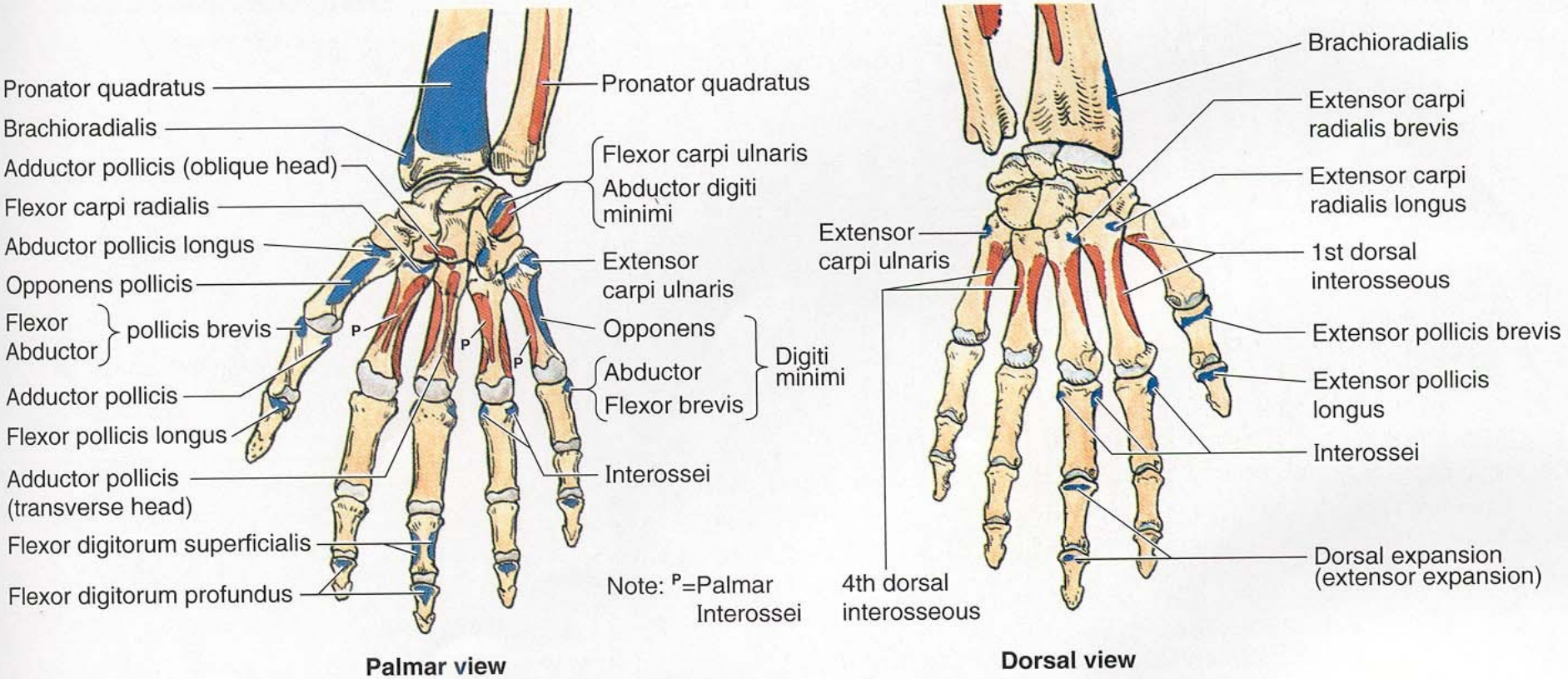
**Extensor**

Simple method of demonstrating arrangement of flexor digitorum superficialis tendon quartet within carpal tunnel

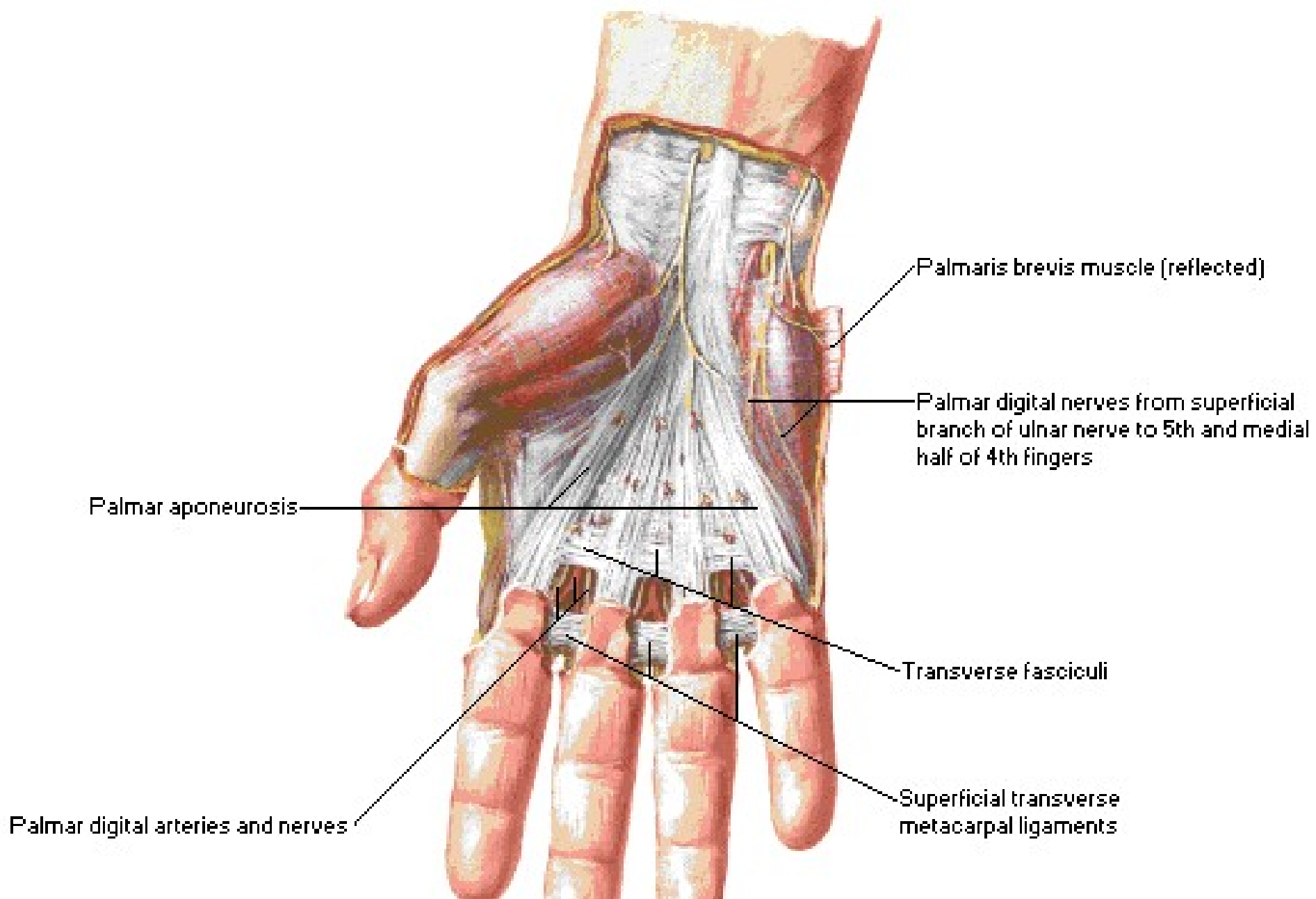
# Muscles Of The Hand

- Muscles in Ball of Thumb
  - Thenar mm
    - Adductor pollicis m
- Muscles in Ball of Little Finger
  - Hypothenar mm
- Midpalmar Muscles
  - Lumbrical mm
  - Interosseus mm

**Table 6.10. Intrinsic Muscles of the Hand**



Muscle	Proximal Attachment	Distal Attachment	Innervation <sup>a</sup>	Main Action
Thenar muscles Abductor pollicis brevis	Flexor retinaculum and tubercles of scaphoid and trapezium	Lateral side of base of proximal phalanx of thumb	Recurrent branch of median nerve (C8 and T1)	Abducts thumb and helps oppose it
Flexor pollicis brevis				Flexes thumb
Opponens pollicis		Lateral side of 1st metacarpal		Draws 1st metacarpal bone laterally to oppose thumb toward center of palm and rotates it medially

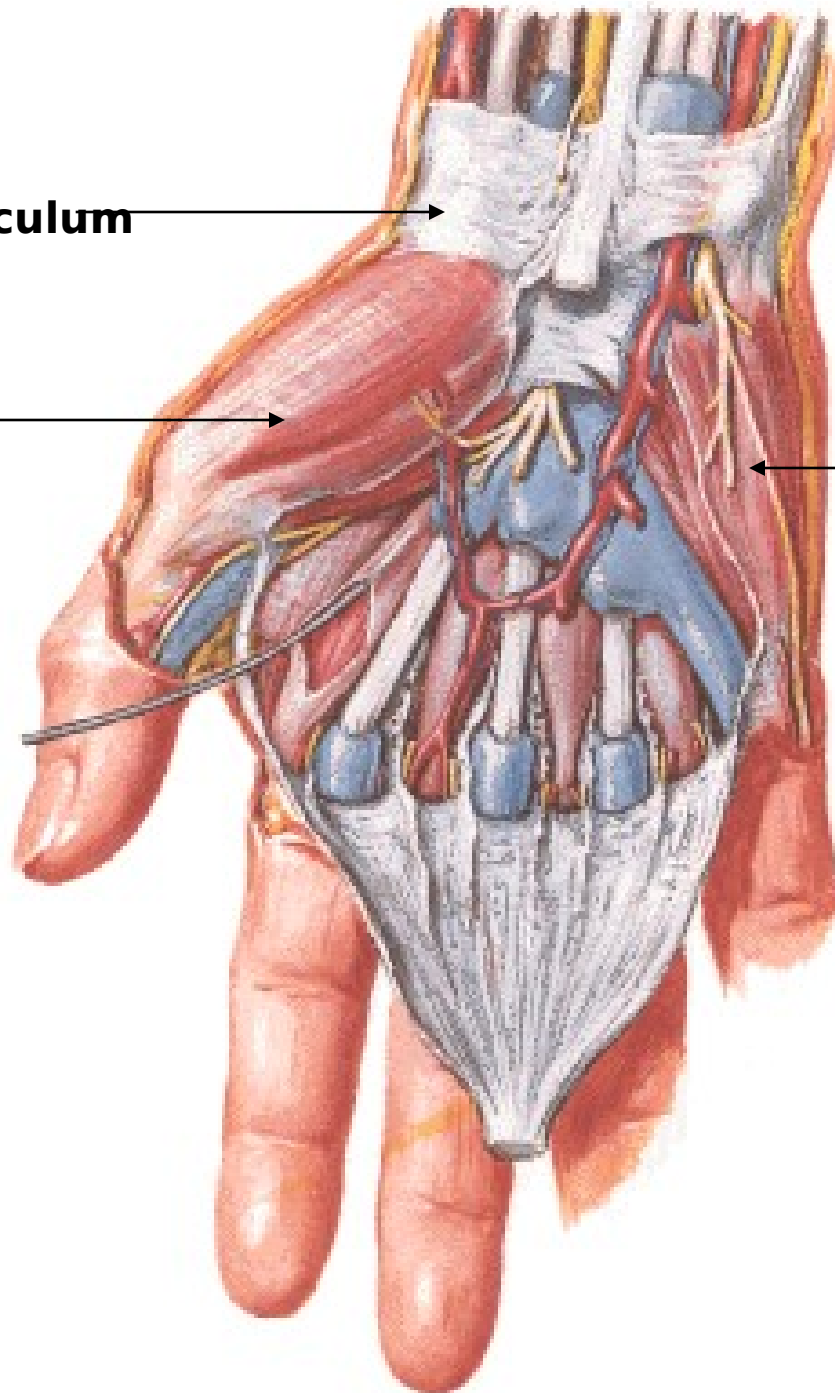




**Flexor retinaculum**

**Thenar muscles**

**Hypothenar muscles**



# Muscles of the Rt. Palm

**Pronator quadratus m.**

**Flexor digitorum profundus m., tendons**

**Abductor pollicis brevis m.**

**Abductor digiti minimi**

**Opponens pollicis m.**

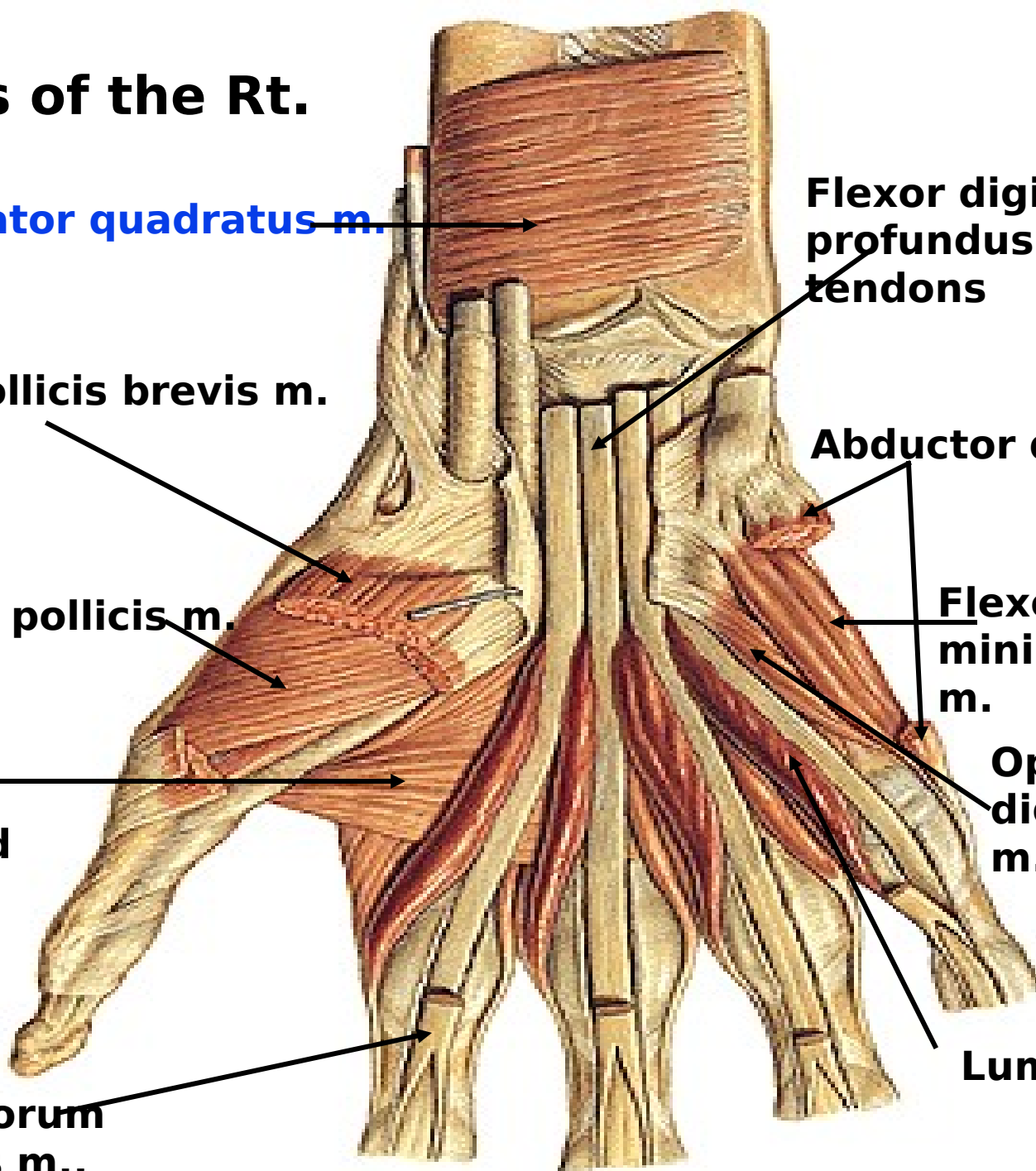
**Flexor digiti minimi brevis m.**

**Adductor pollicis m., transv. head**

**Opponens digiti minimi m.**

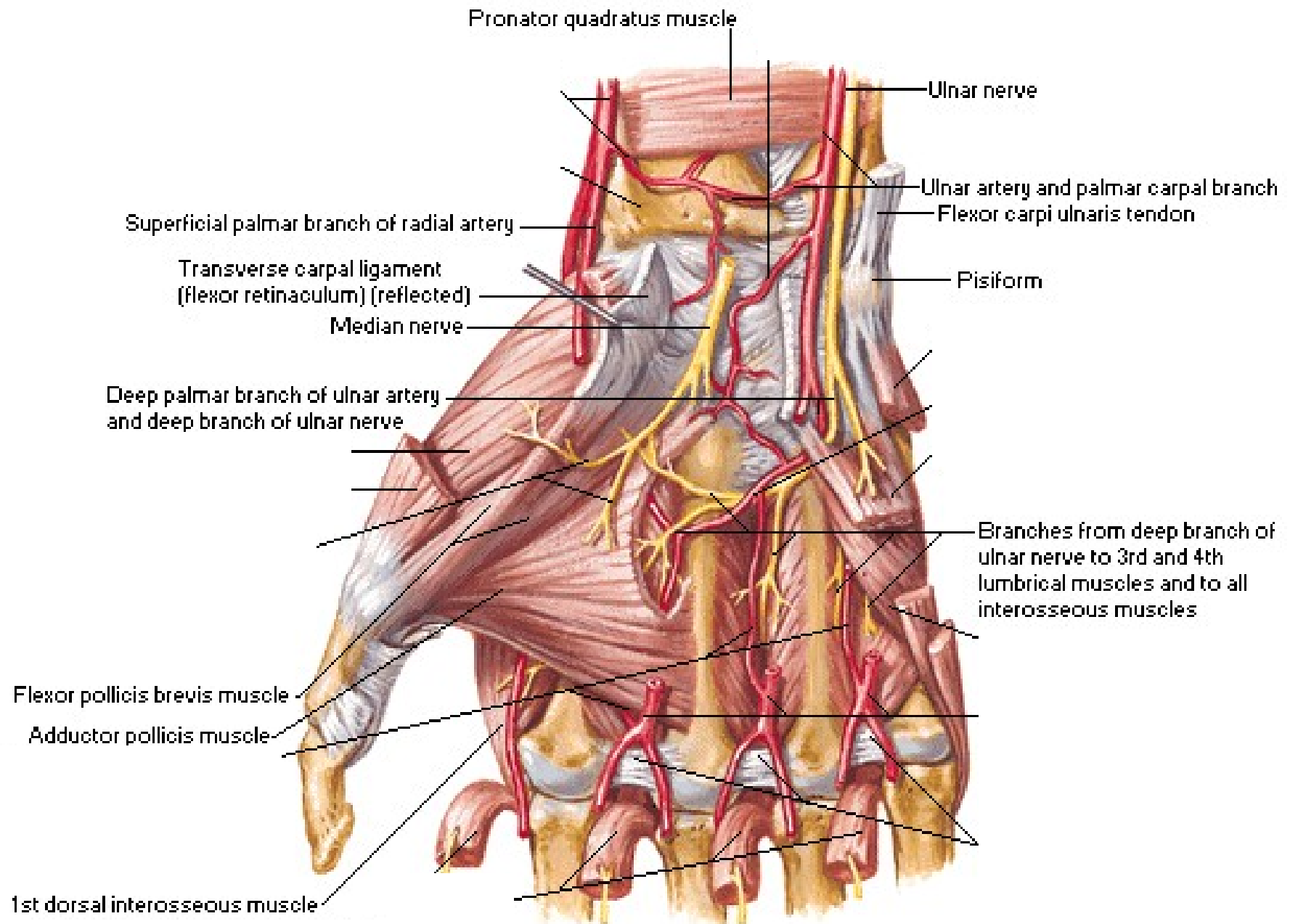
**Lumbrical mm.**

**Flexor digitorum superficialis m.,**





# Anterior [Palmar] View



Tendons of:

Flexor digitorum profundus

Flexor digitorum superficialis

Third lumbrical

Fourth lumbrical

Opponens digiti minimi

Flexor digiti minimi brevis

Abductor digiti minimi

Pisiform bone

Flexor carpi ulnaris tendon

Flexor digitorum superficialis tendons

Fibrous sheath

Second lumbrical

Dorsal interossei

First lumbrical

Adductor pollicis

Flexor pollicis brevis

Abductor pollicis brevis

Opponens pollicis

Flexor retinaculum

Abductor pollicis longus

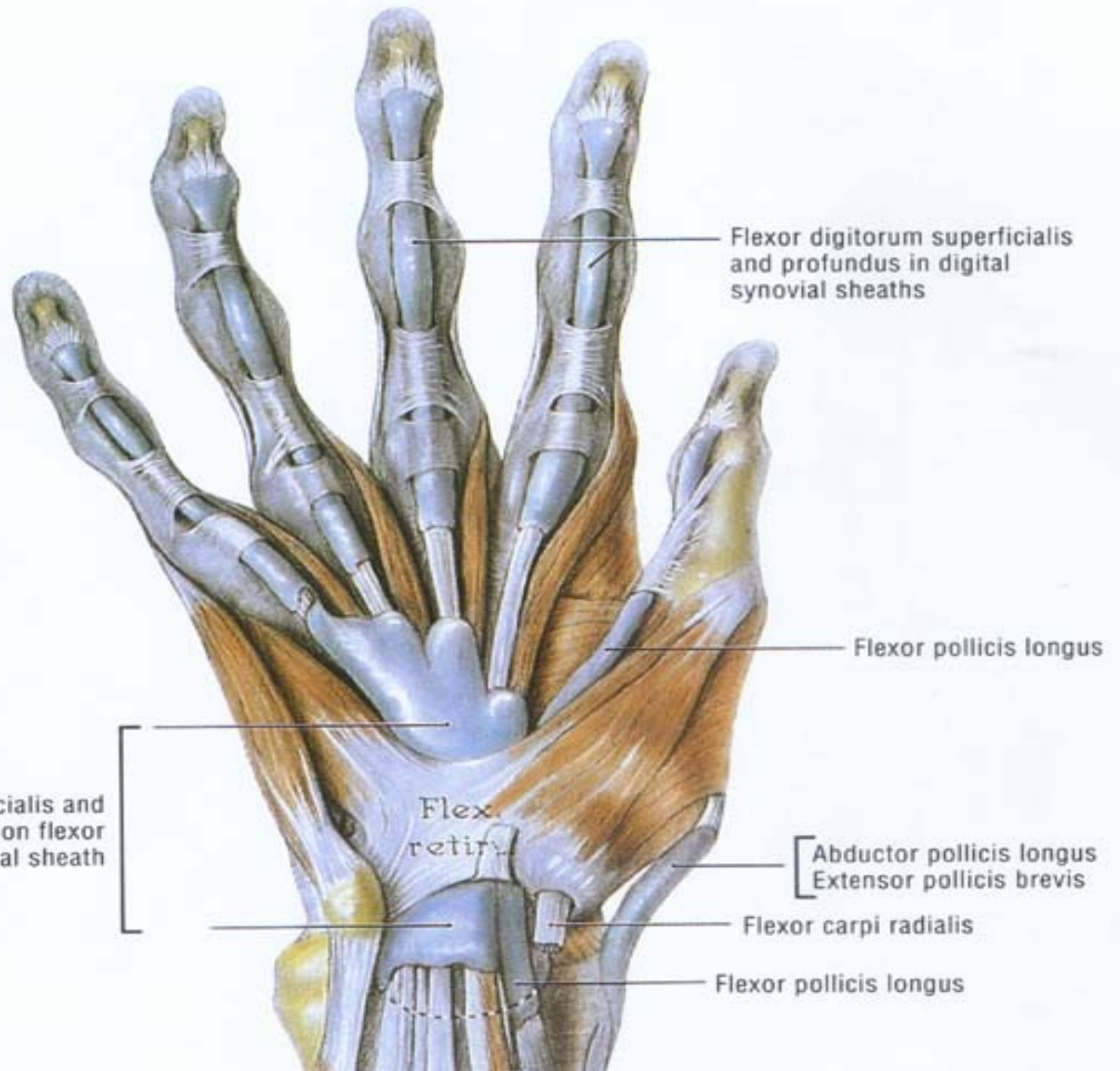
Tendons of:

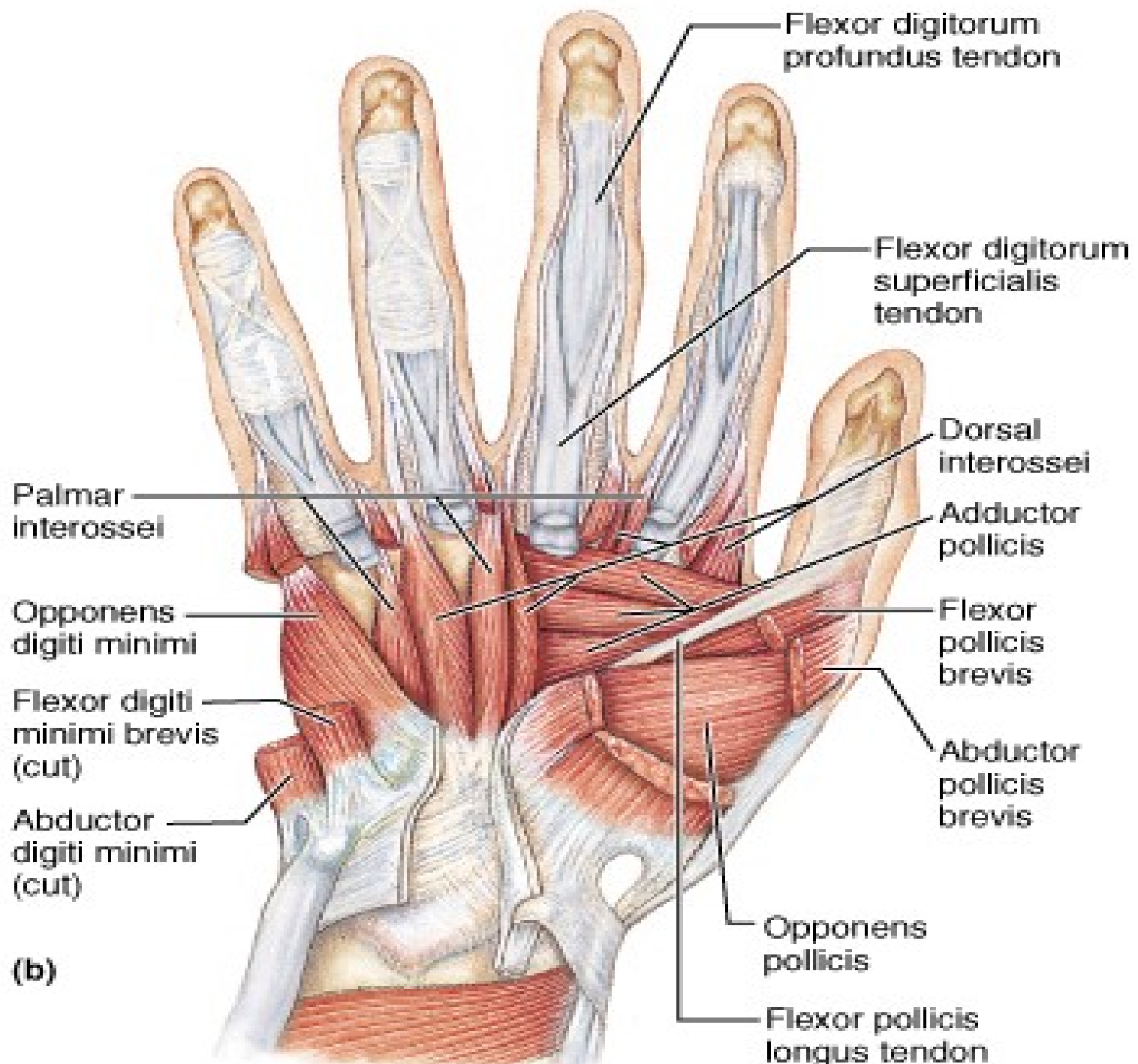
- Palmaris longus

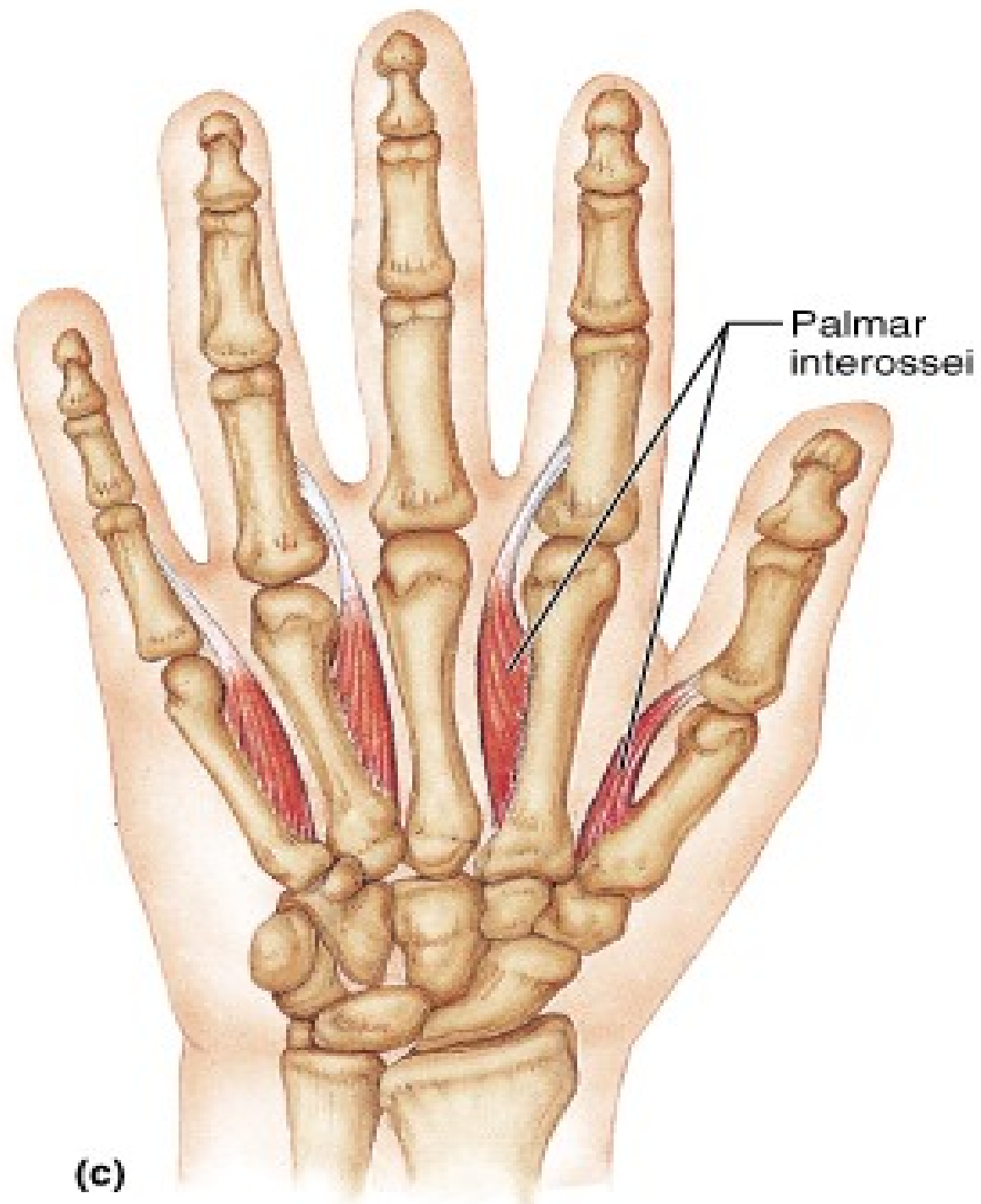
- Flexor carpi radialis

- Flexor pollicis longus

(a)

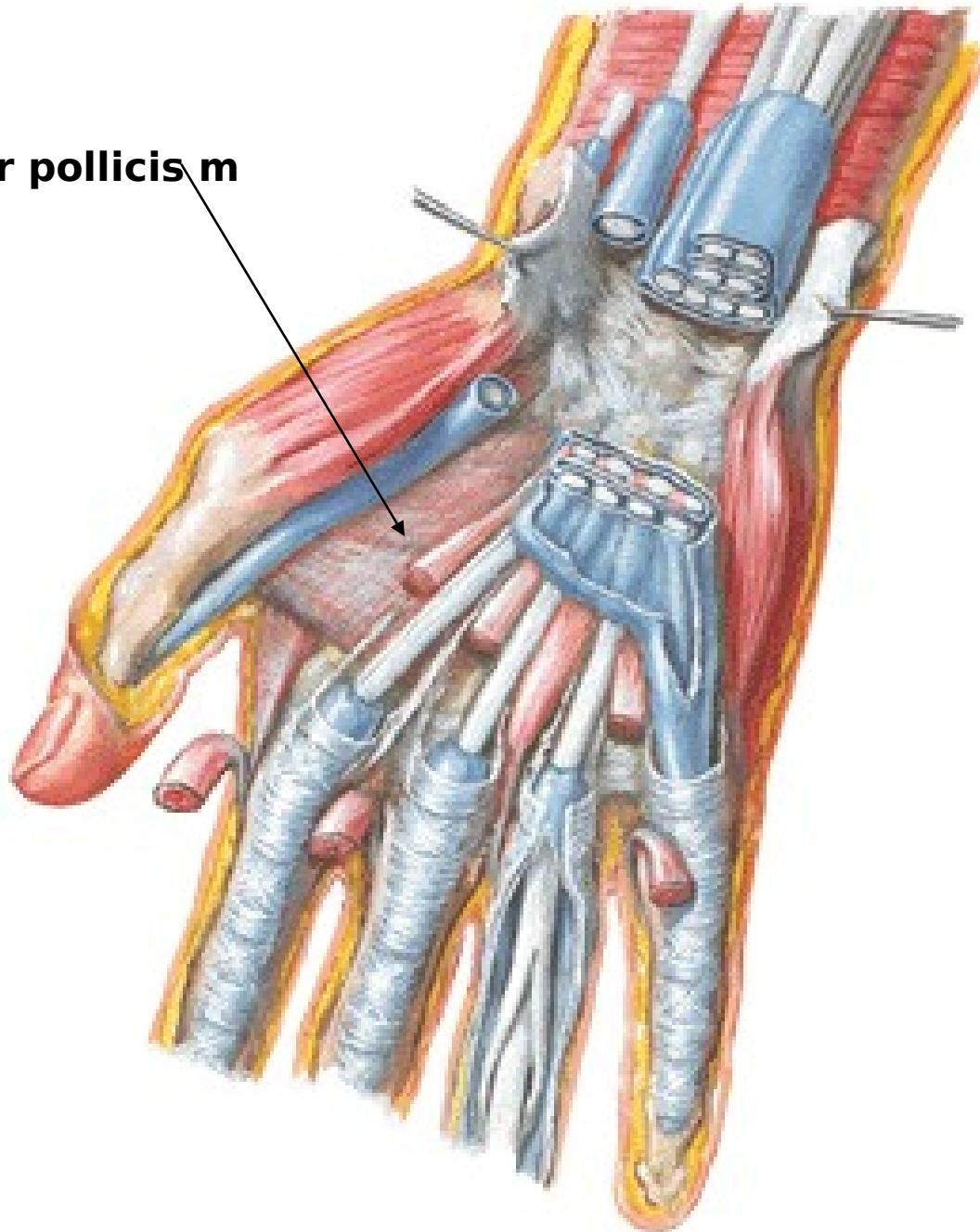


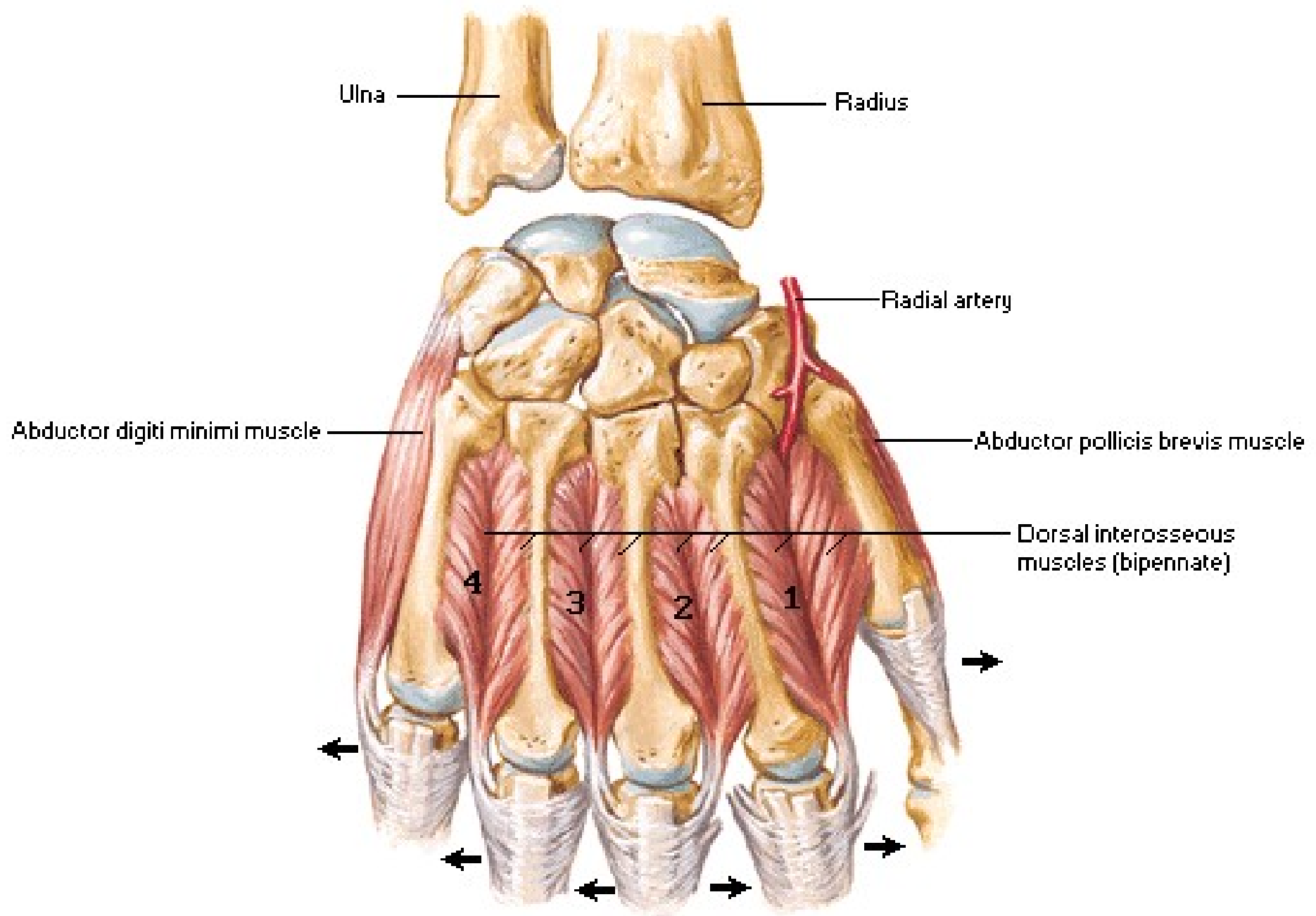




(c)

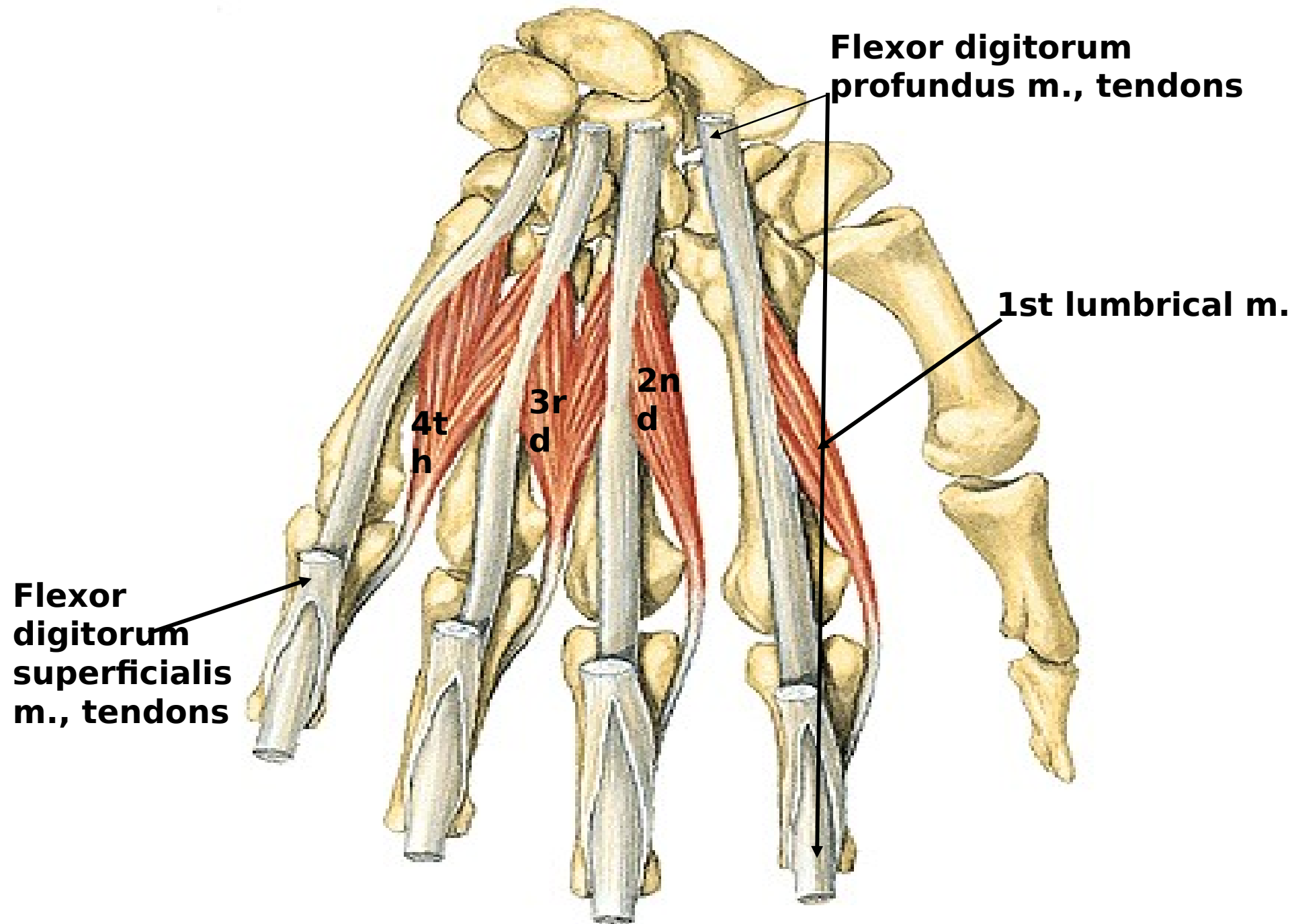
**Adductor pollicis m**

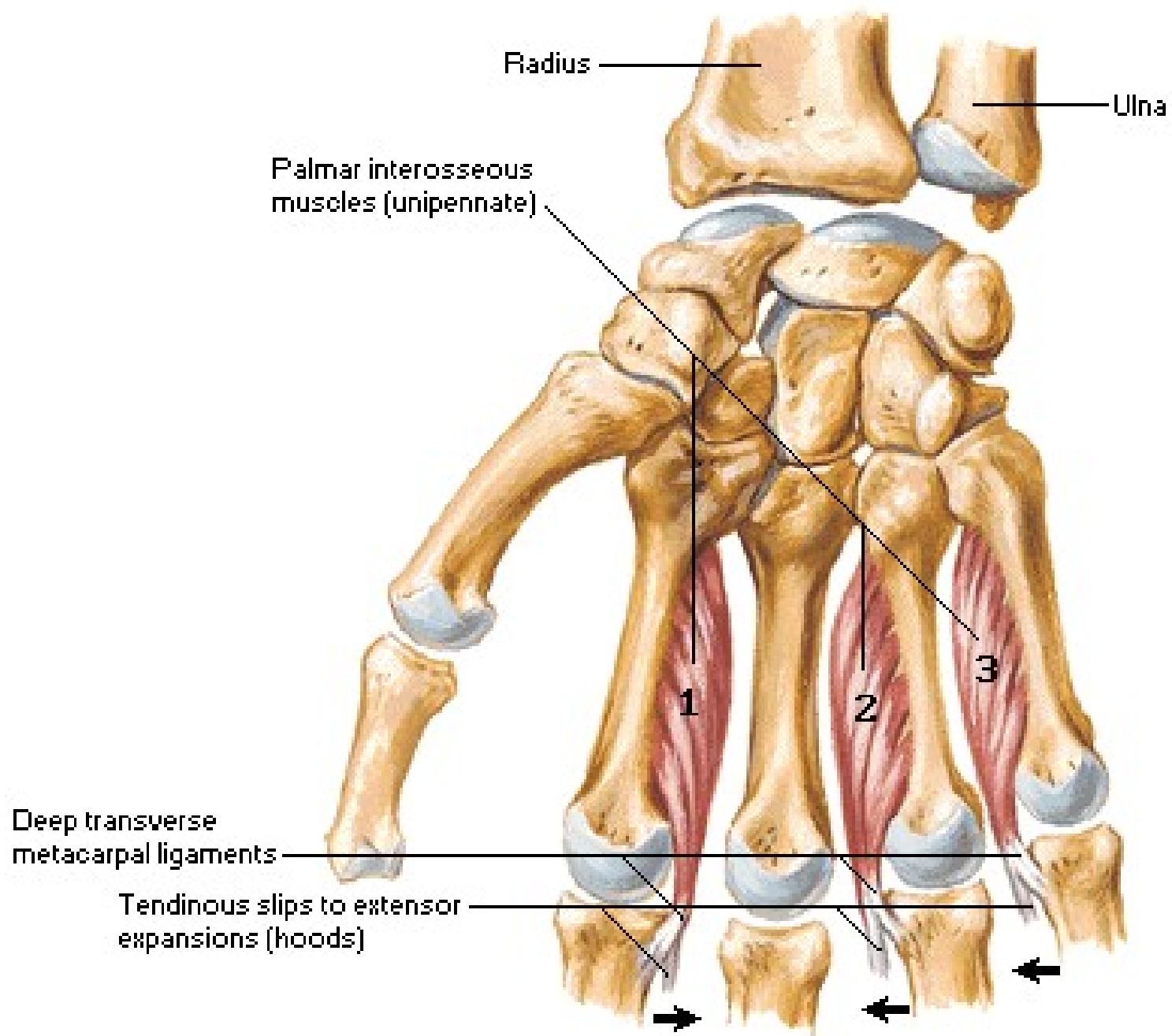




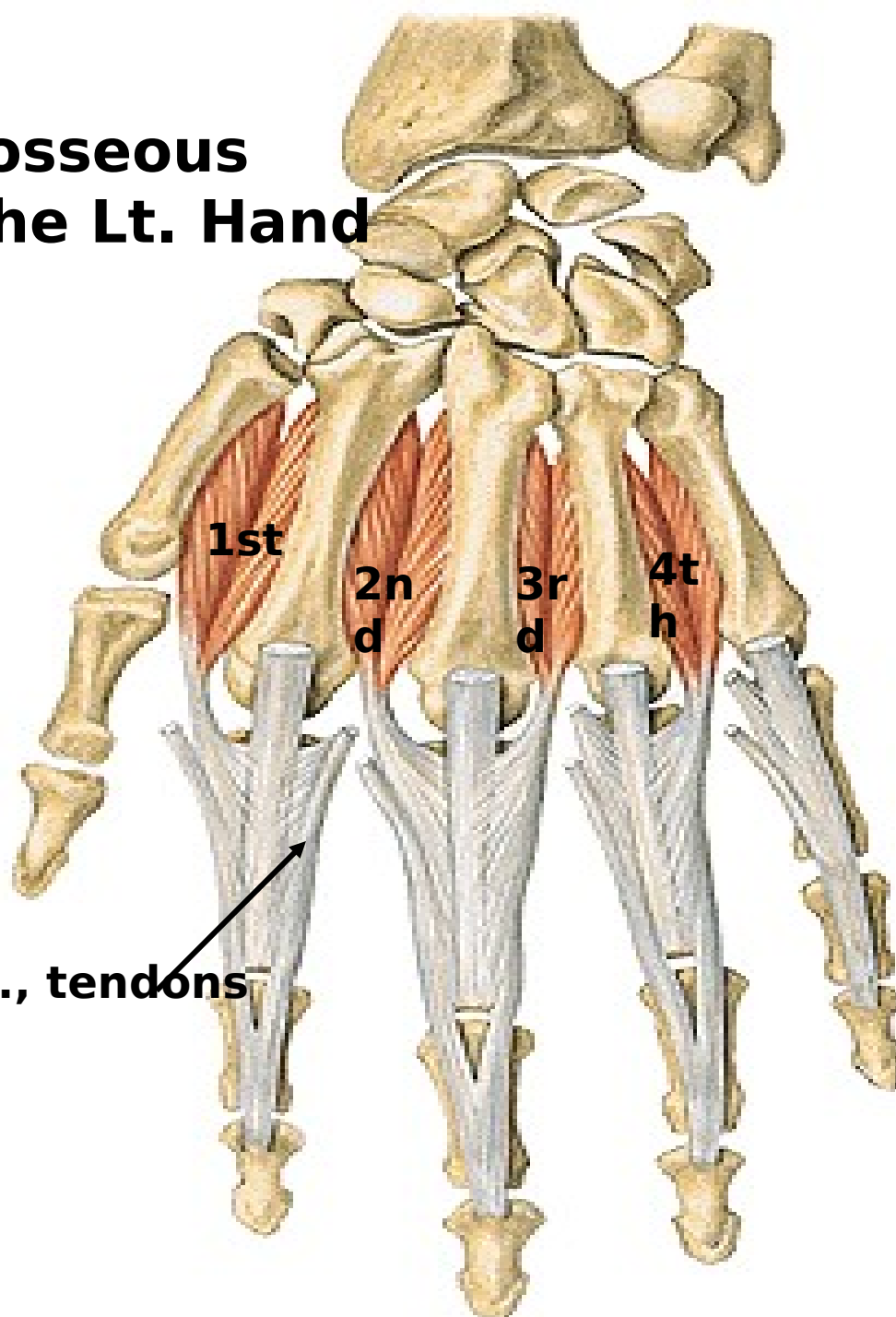
Note: arrows indicate action of muscles





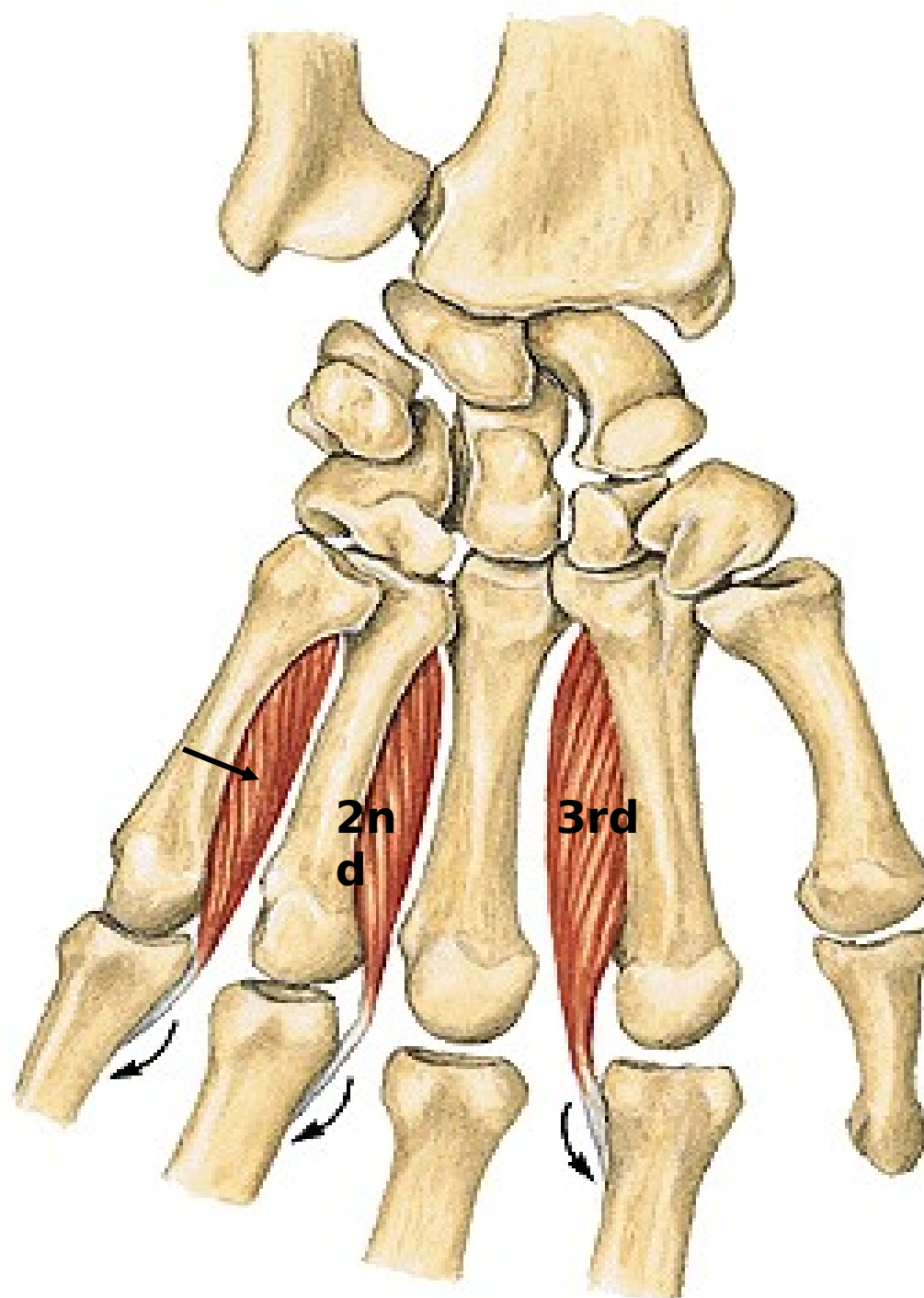


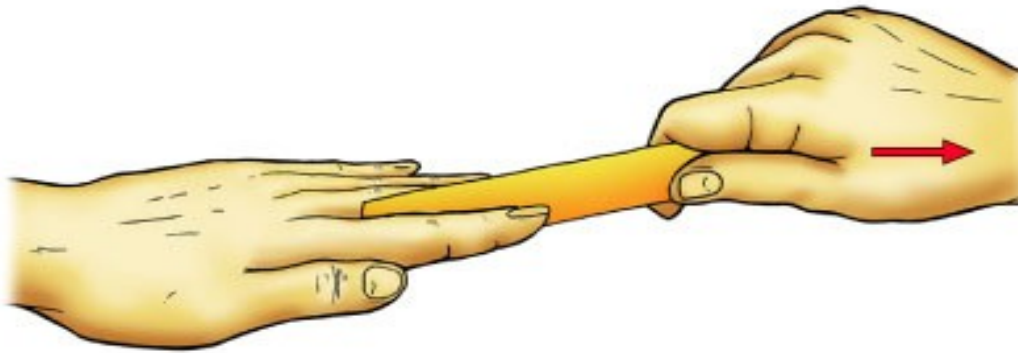
# Dorsal Interosseous Muscles of the Lt. Hand



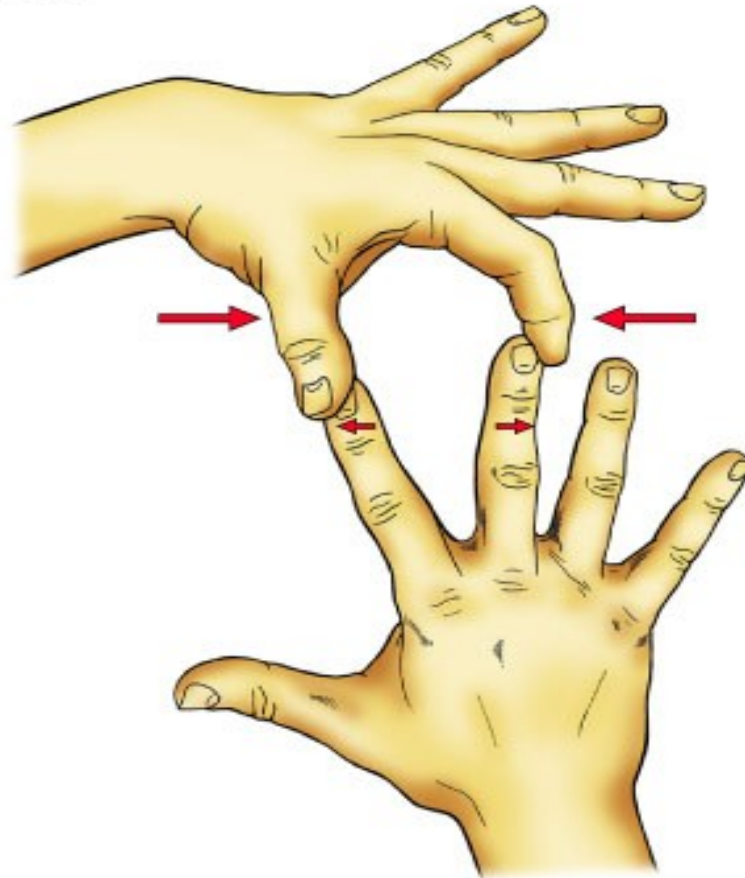
Lumbrical mm., tendons

**1<sup>st</sup> Palmar  
Interosseous m.**



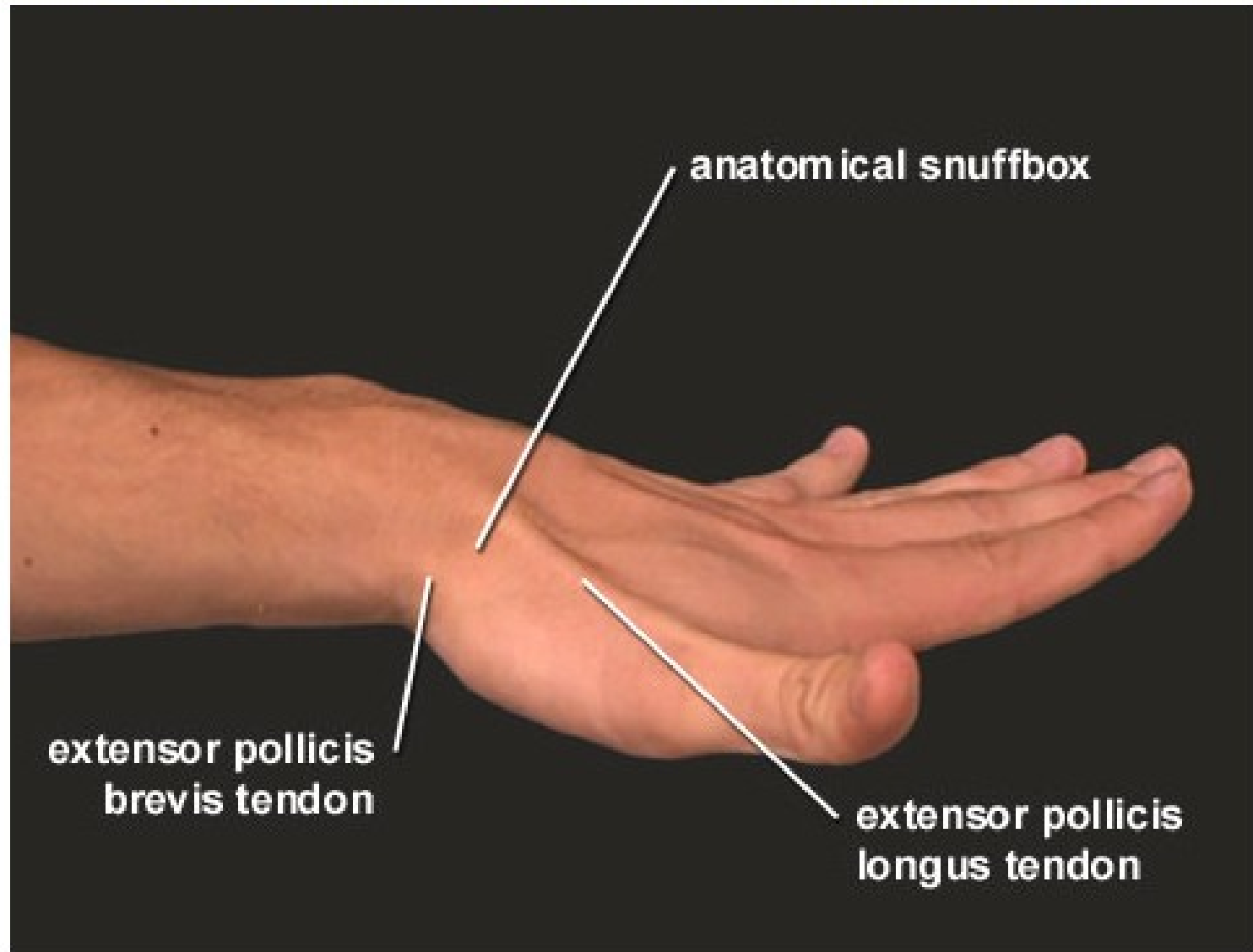


(A) Adduction



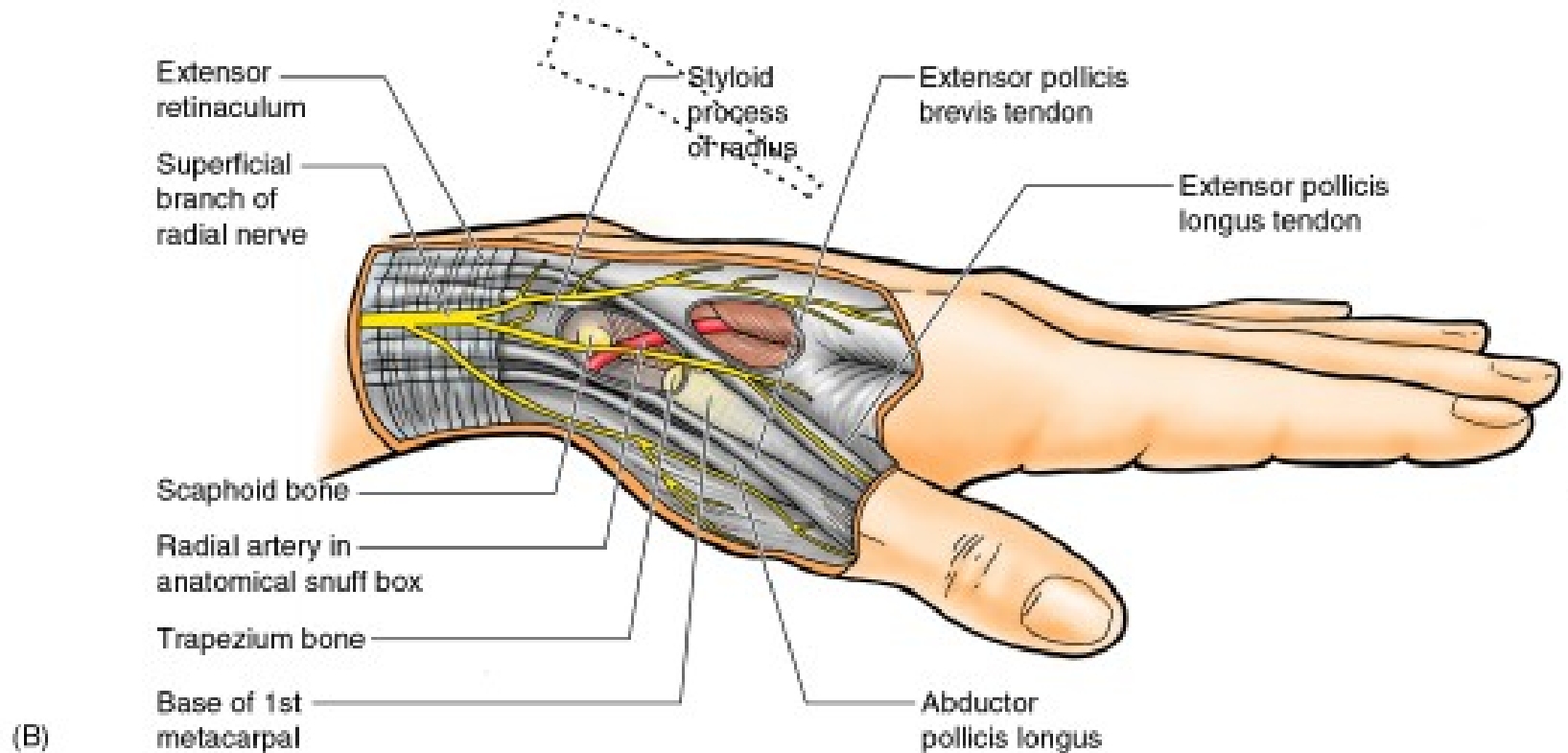
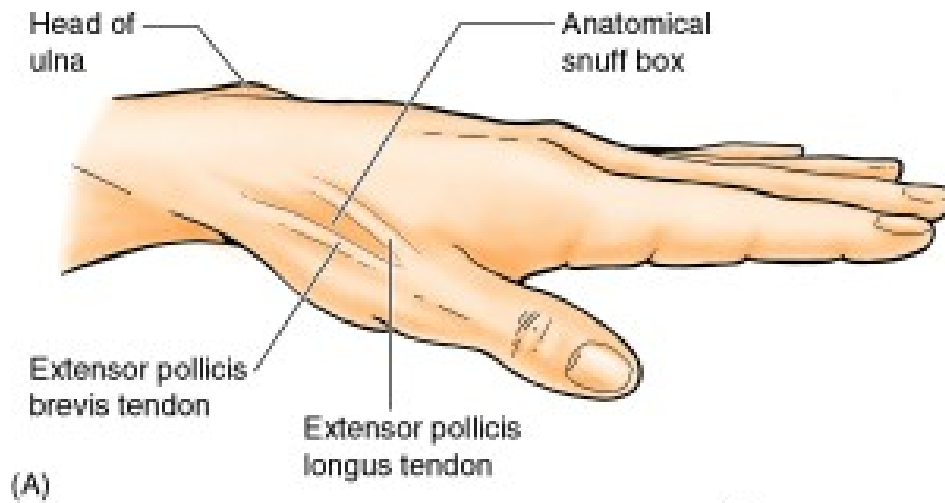
(B) Abduction

## Surface Anatomy: Anatomical Snuffbox (left)



**Deep within the snuffbox lies the radial artery**

6.46A, B. Radial artery in the anatomical snuff box.



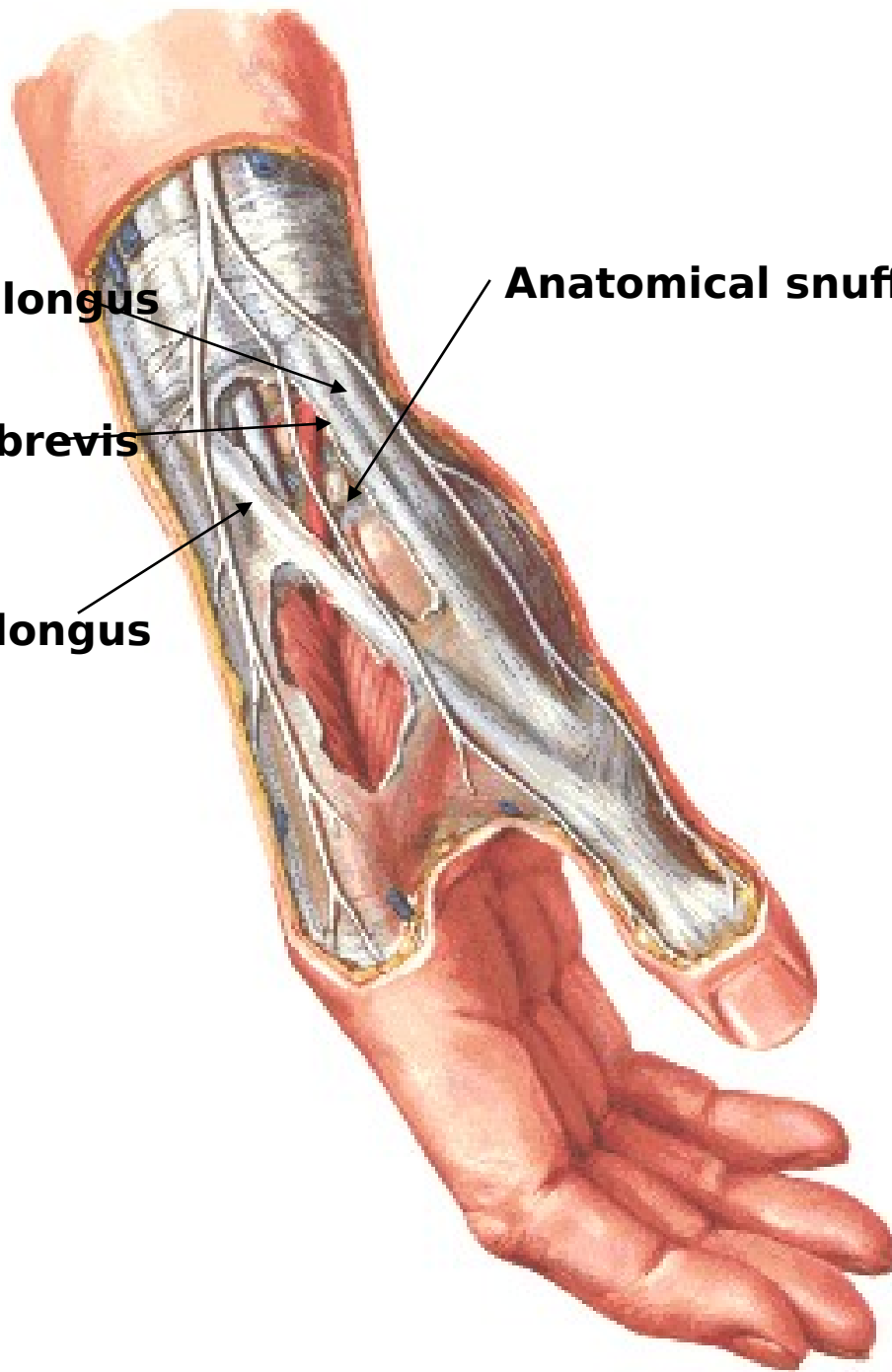


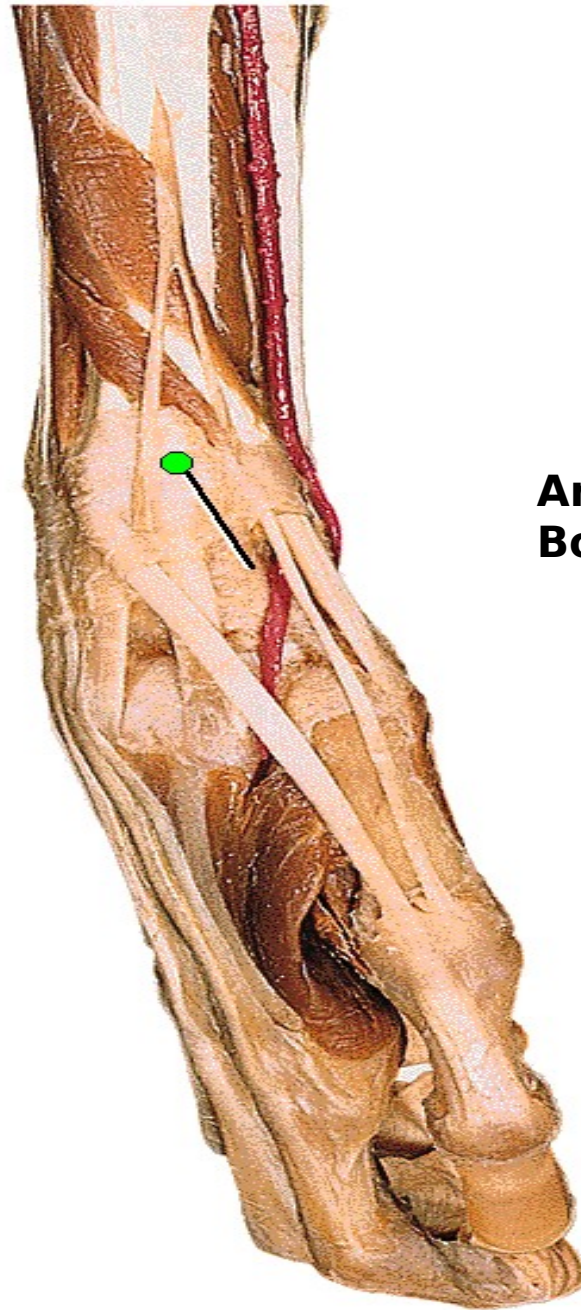
**Abductor pollicis longus**

**Extensor pollicis brevis**

**Extensor pollicis longus**

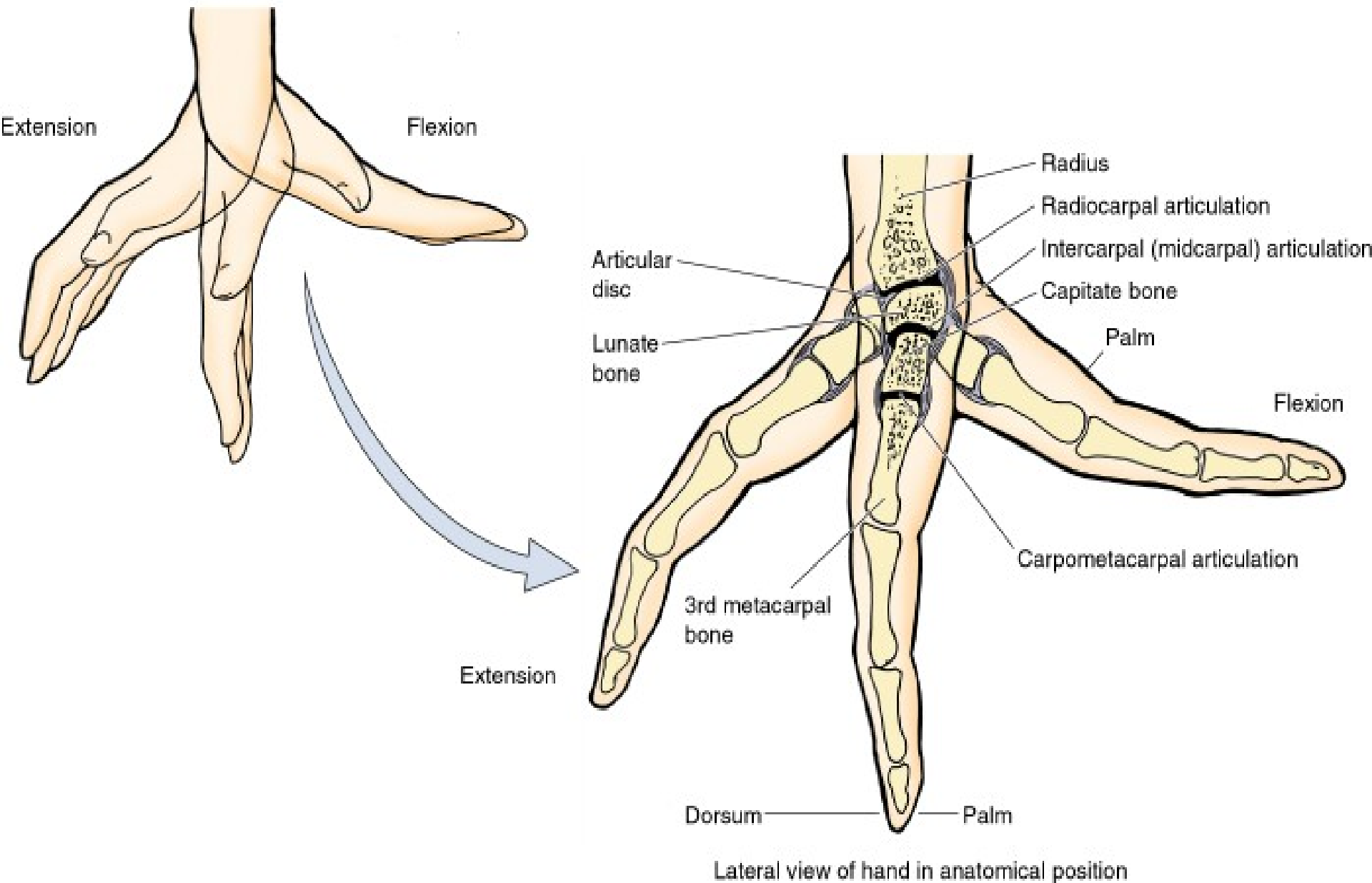
**Anatomical snuffbox**





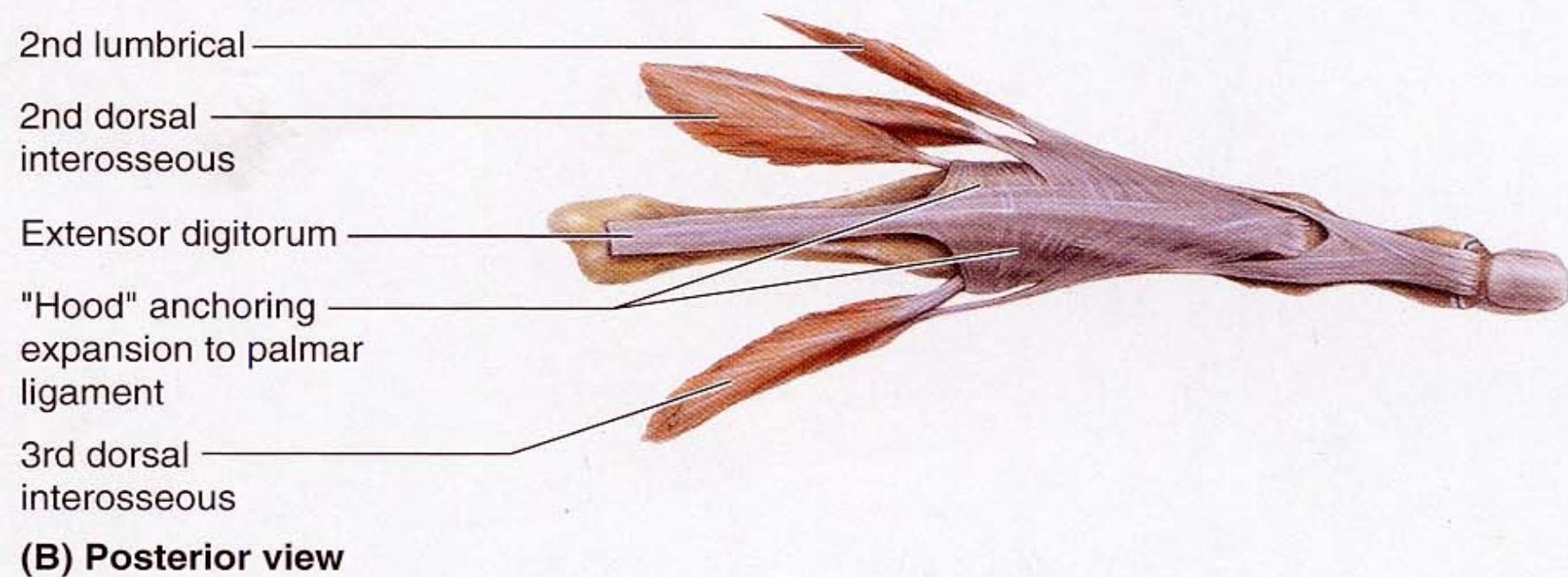
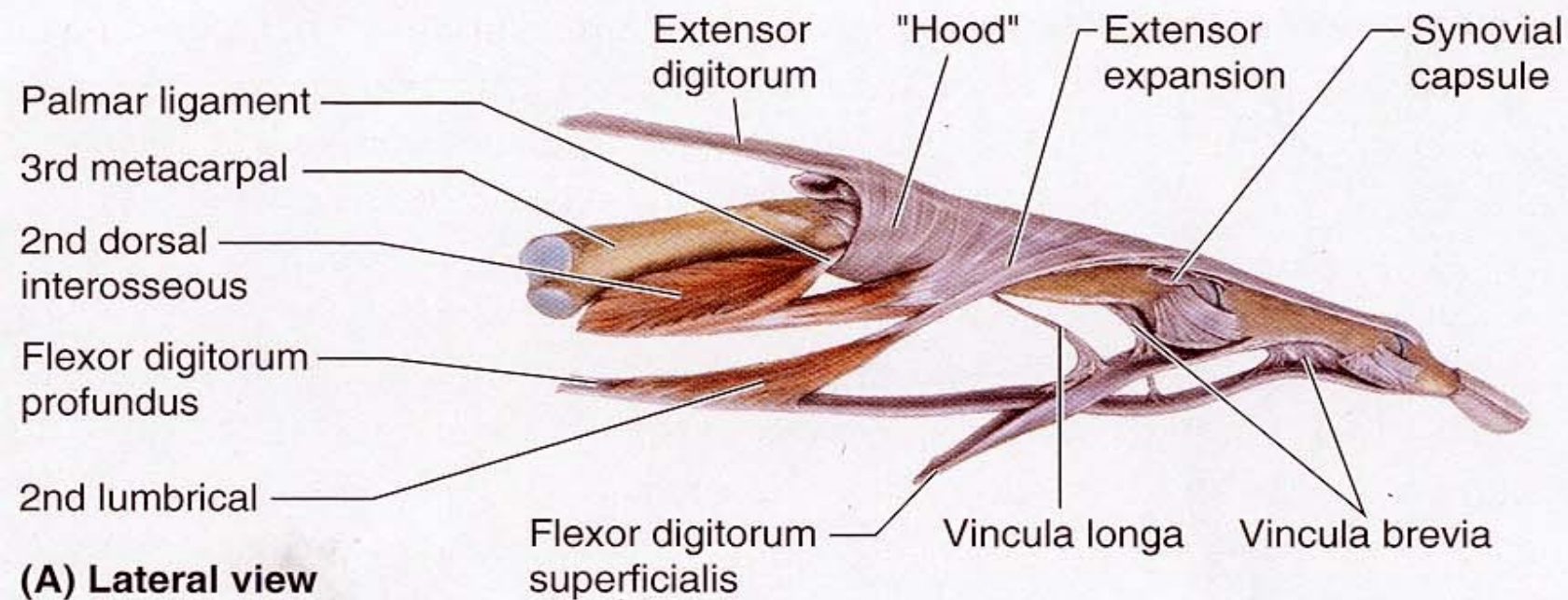
**Anatomical Snuff  
Box**

6.76. Sagittal section of the wrist and hand during extension and flexion.

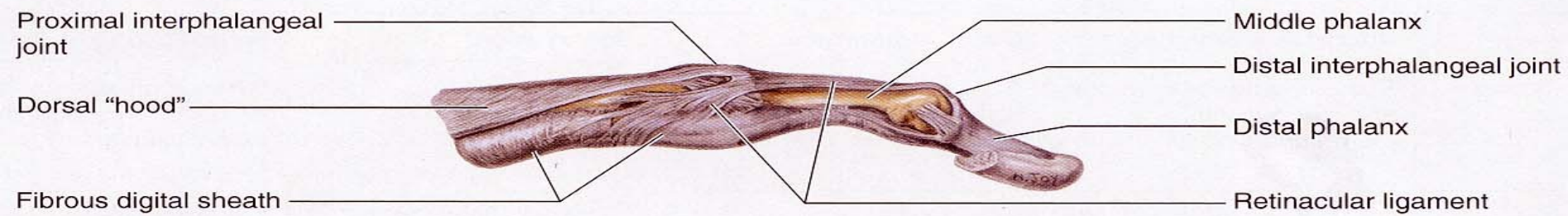




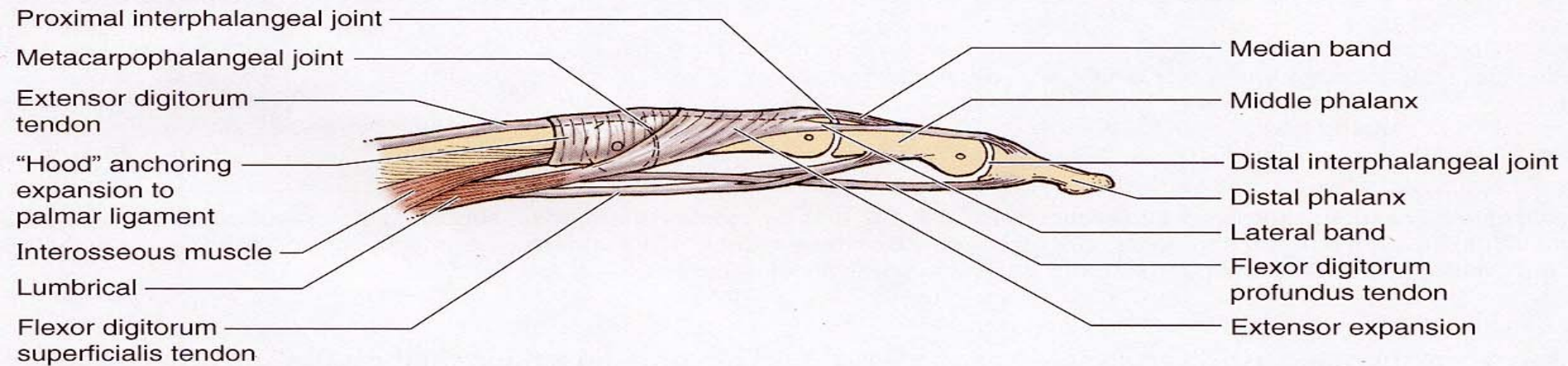
(C) Lateral view, left hand



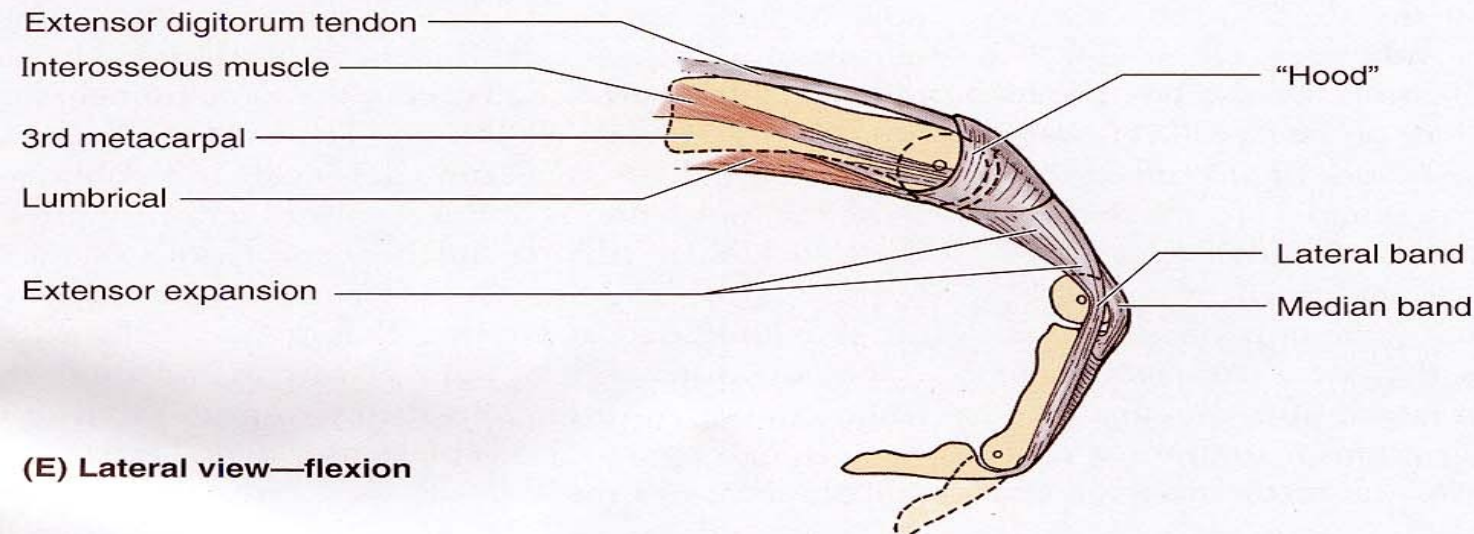




**(C) Lateral view**

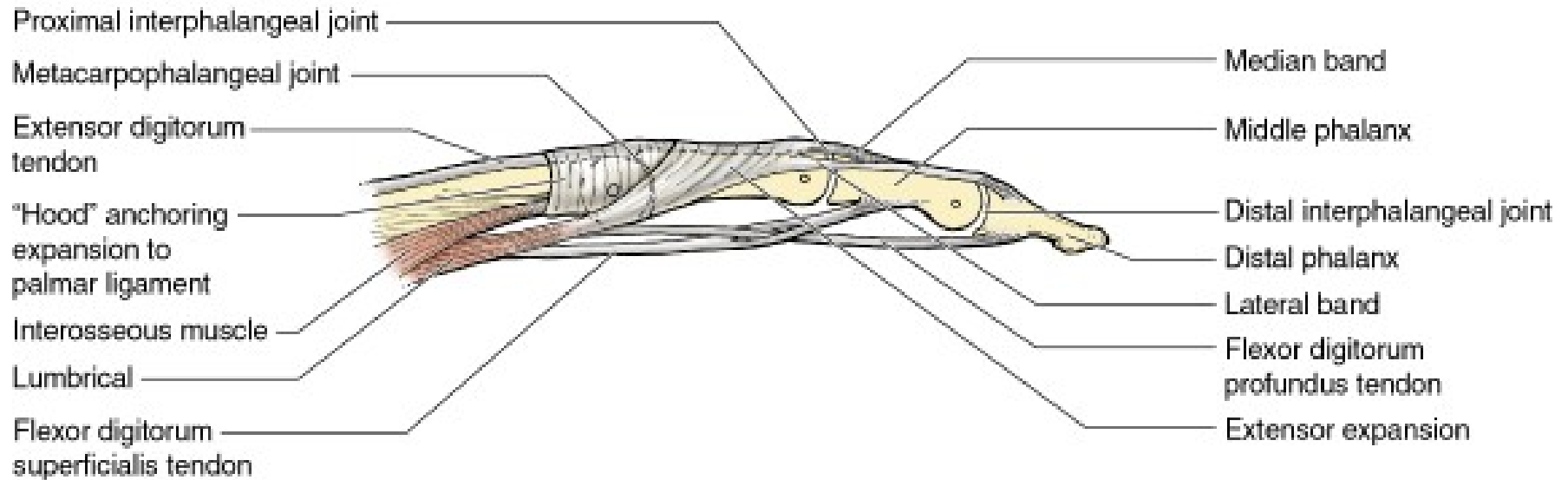


**(D) Lateral view—extension**

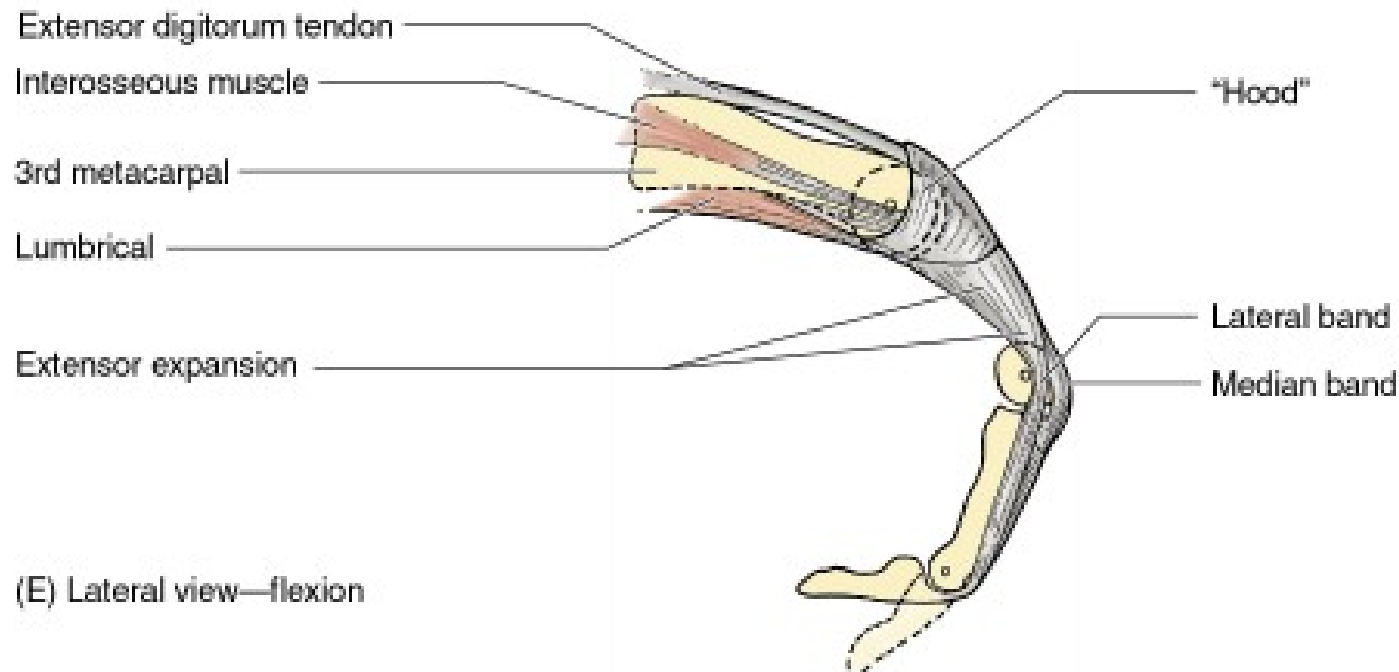


**(E) Lateral view—flexion**

# 6.44D-E. Extension and flexion of the 3rd digit.

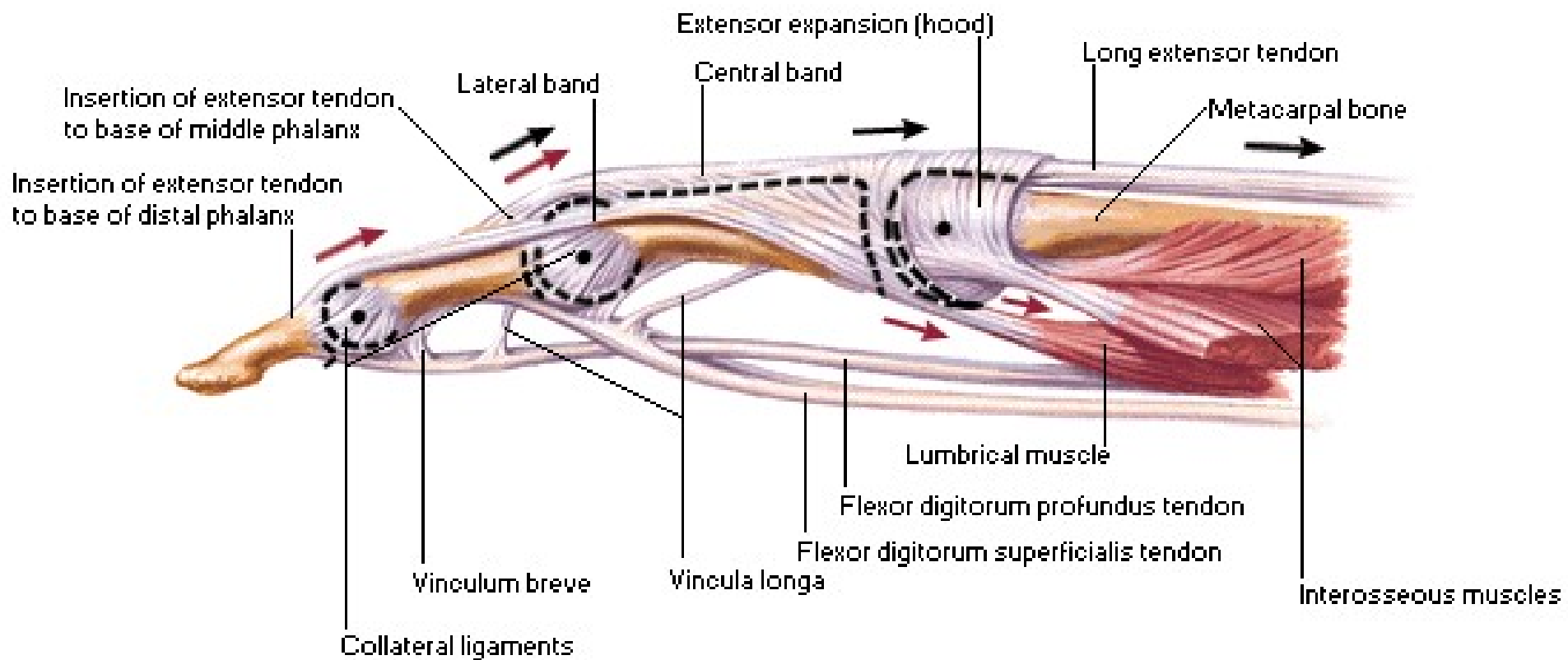


(D) Lateral view—extension

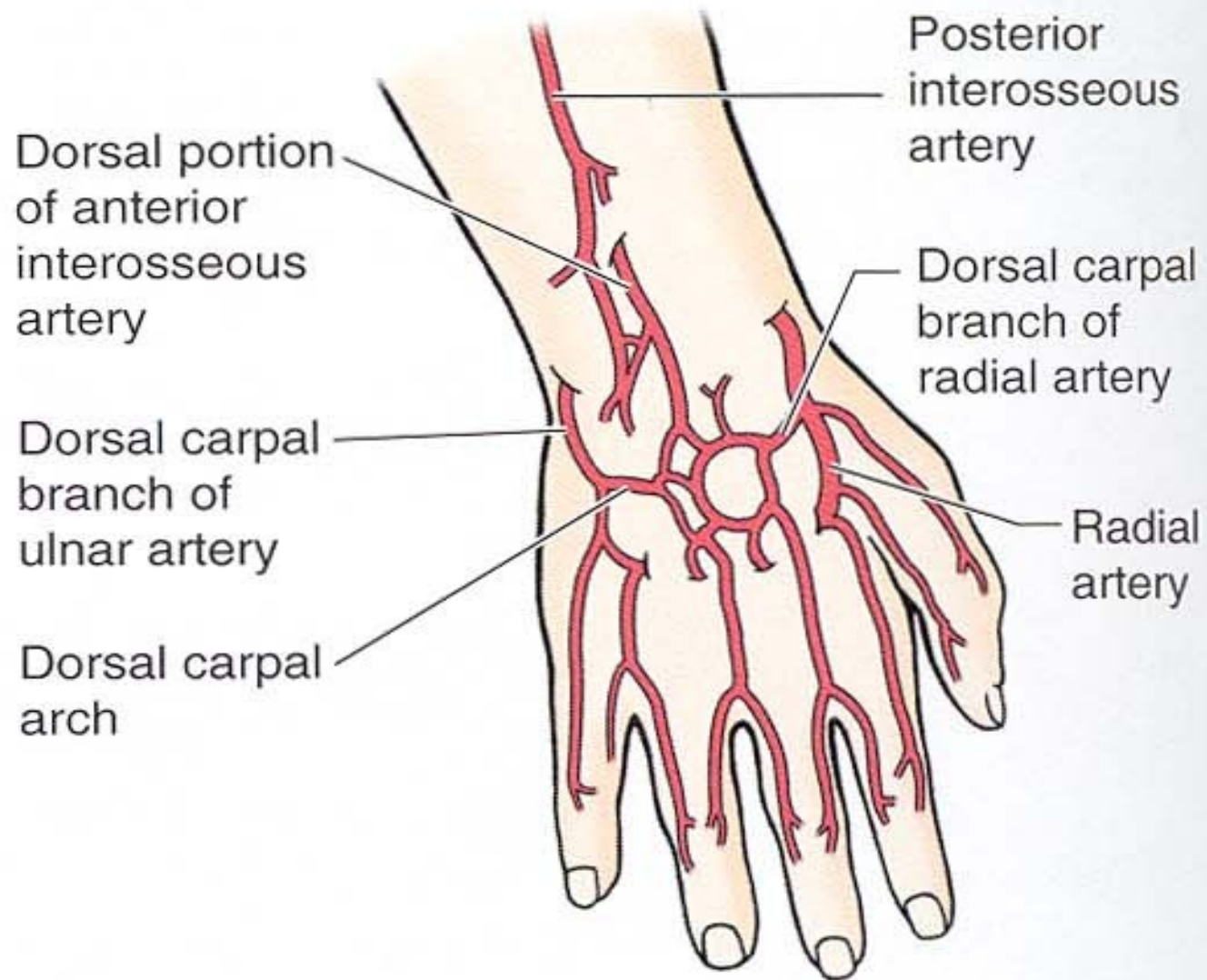


(E) Lateral view—flexion

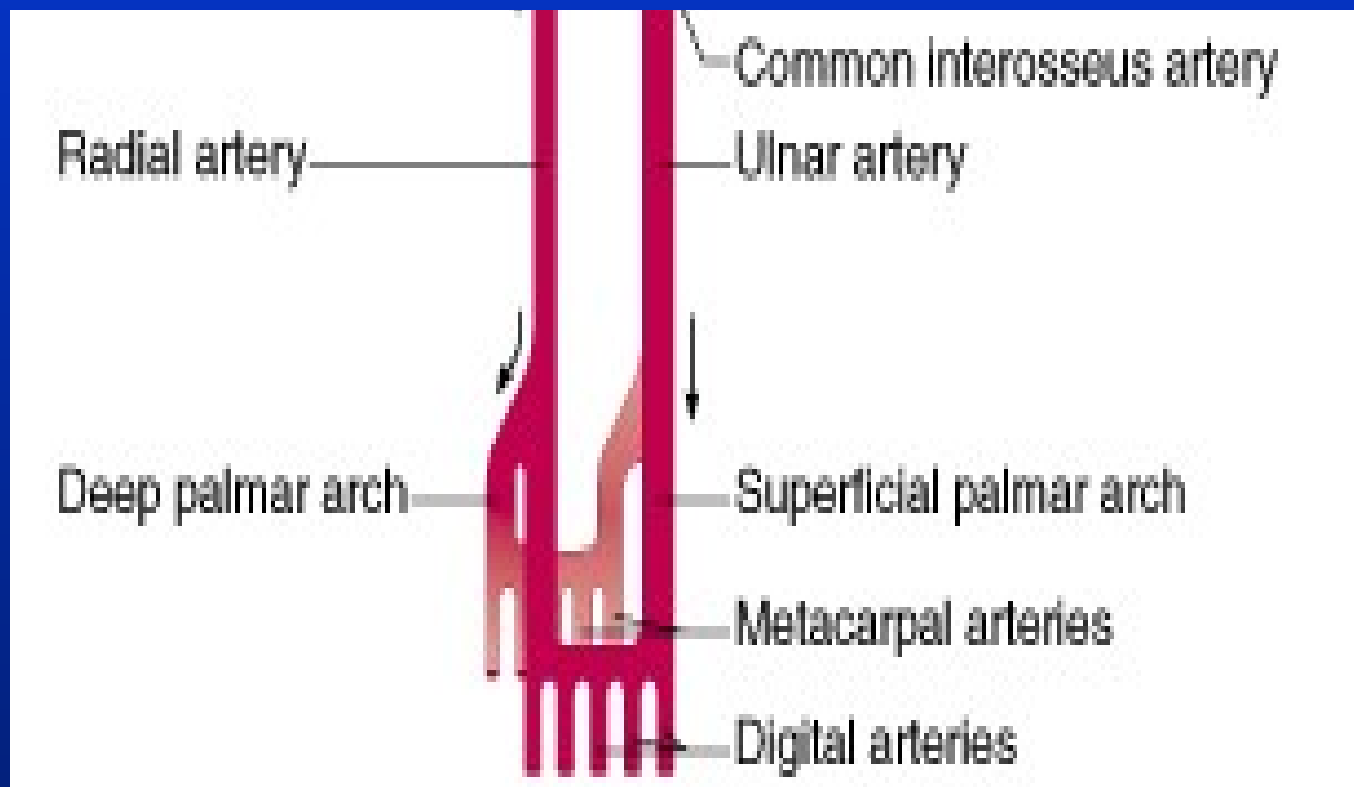




# **BLOOD VESSELS**



**Dorsal view**



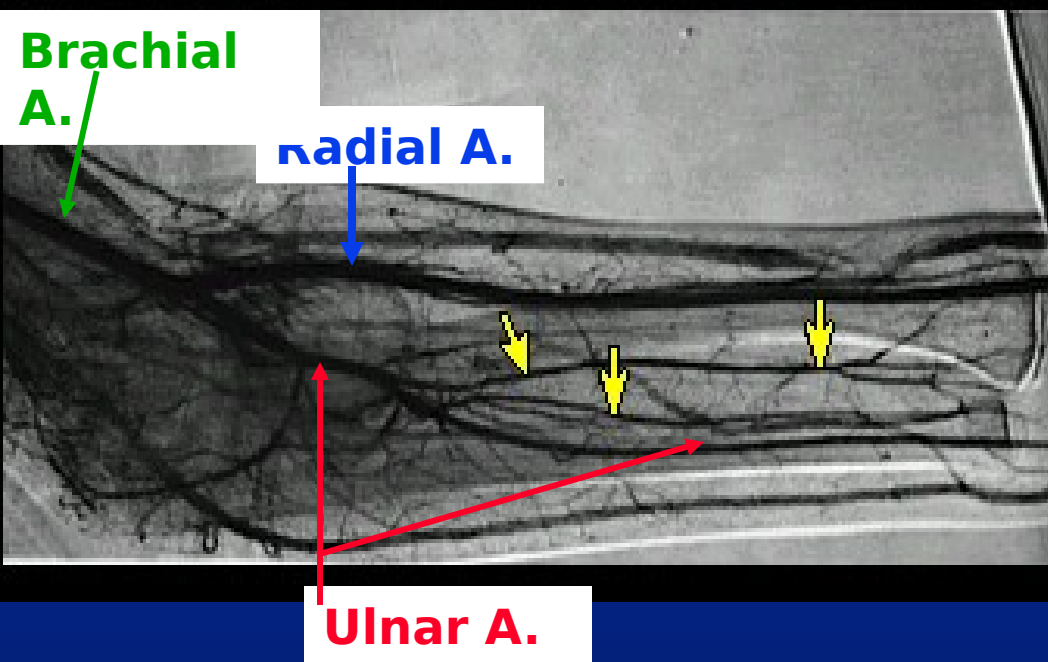
## UE Angiogram, Wrist and Hand



## Deep Palmar Arch

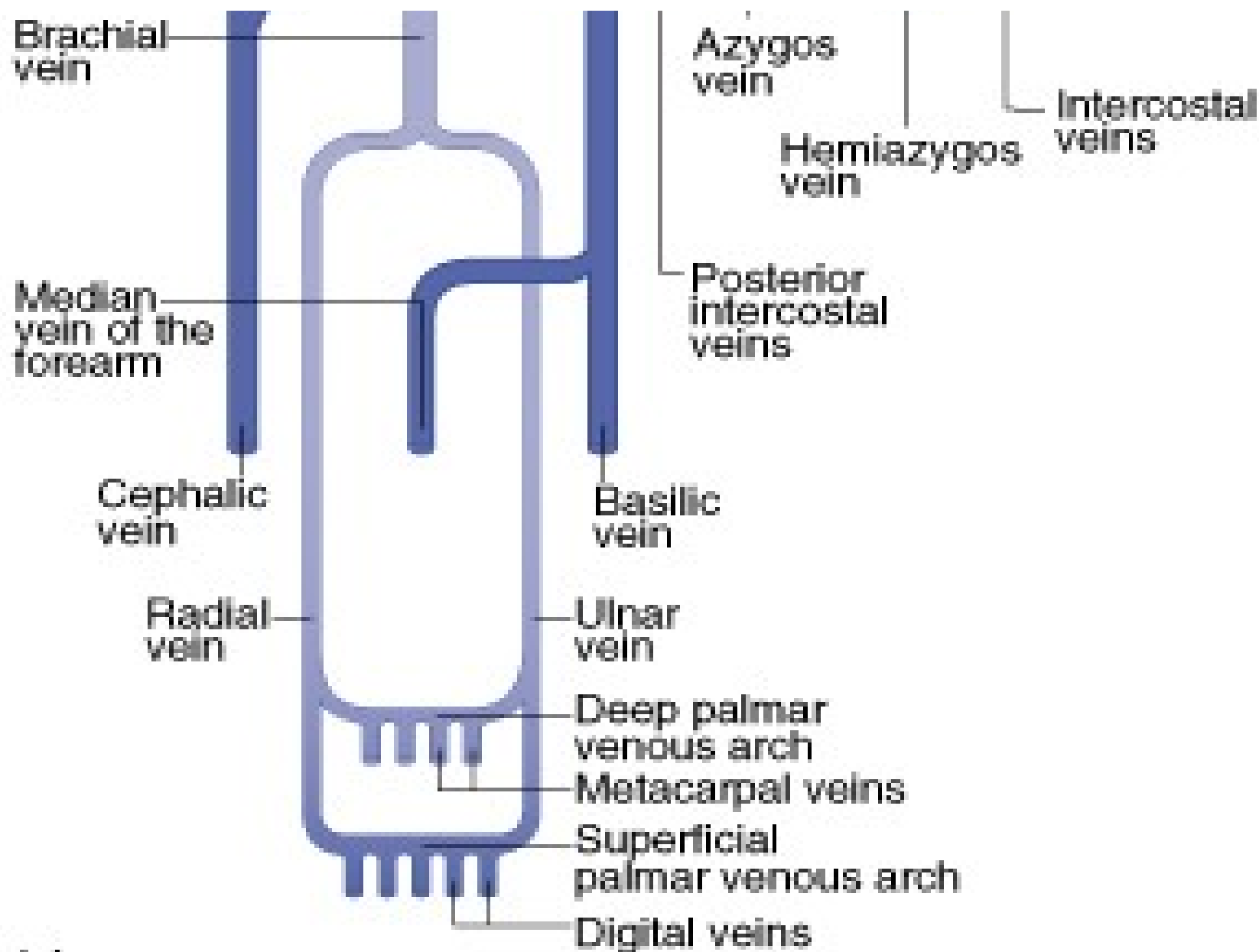
The deep palmar arch of the hand is formed by the radial artery after the branch to the thumb (princeps pollicis artery). Medially there is an accessory contribution by the ulnar artery. The deep palmar arch gives rise to three palmar metacarpal arteries.

## UE Angiogram, Elbow (Subtraction)

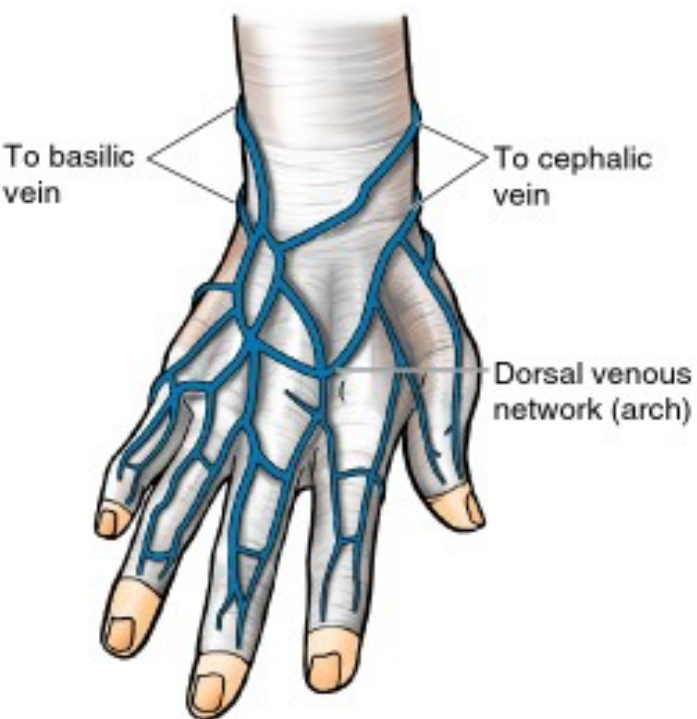


## Interosseous A.

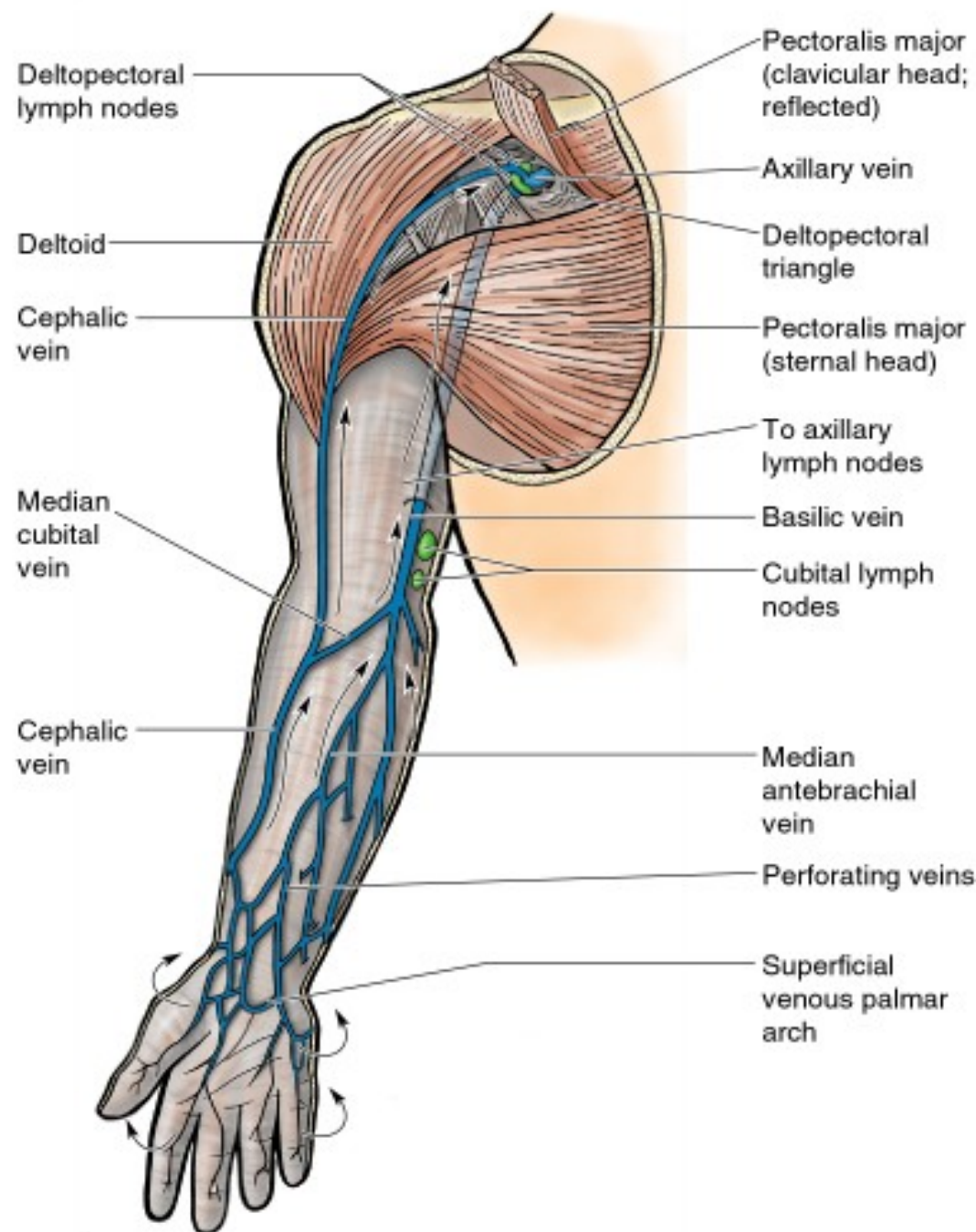
The anterior and posterior interosseous arteries arise from the ulnar artery and pass toward the hand on opposite sides of the interosseous membrane, a fibrous sheet connecting the radius and ulna. These vessels can serve as collateral flow to the hand or elbow if the primary circulation is disrupted. In this view, it is not possible to determine which is the anterior and which is the posterior interosseous branch.





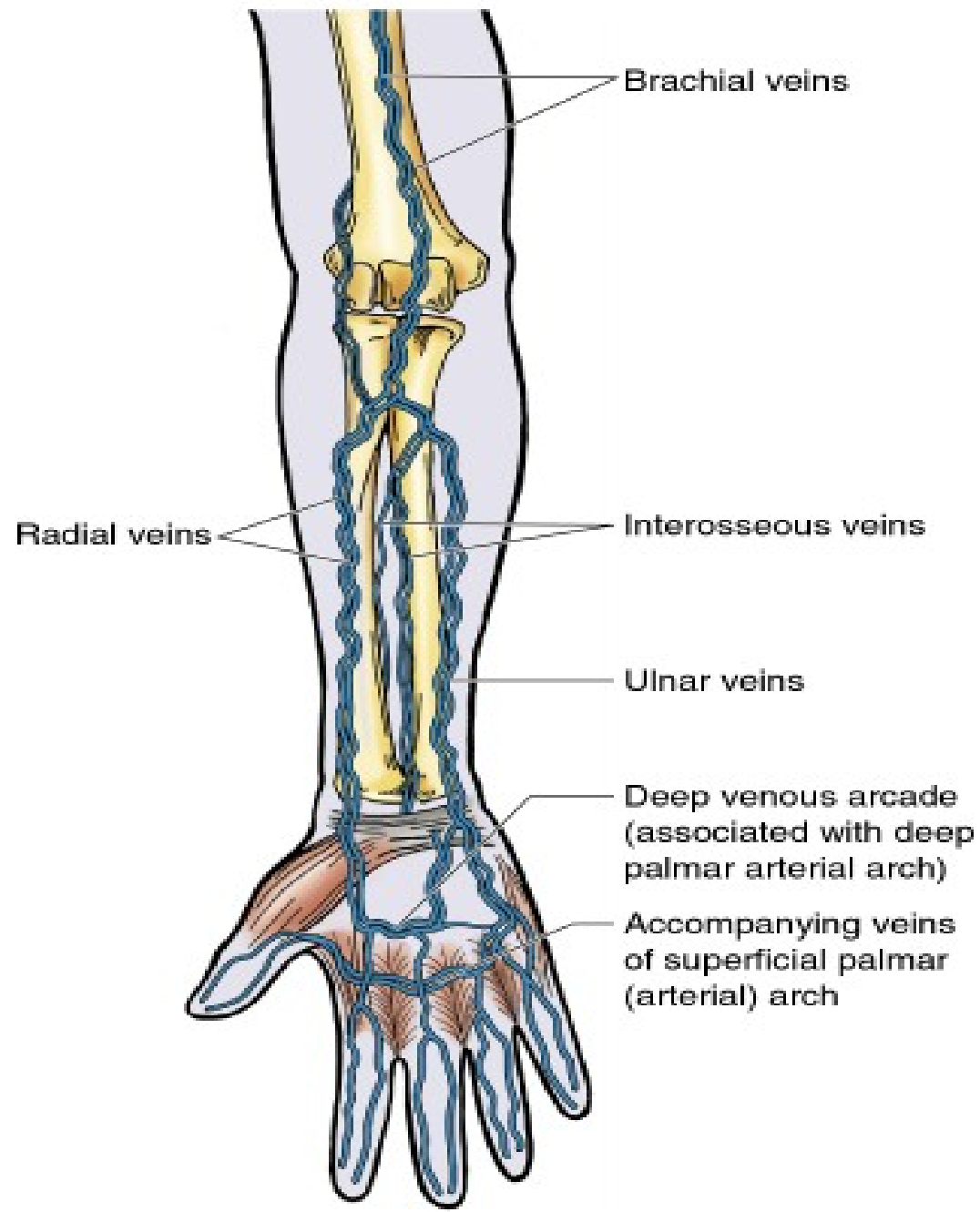


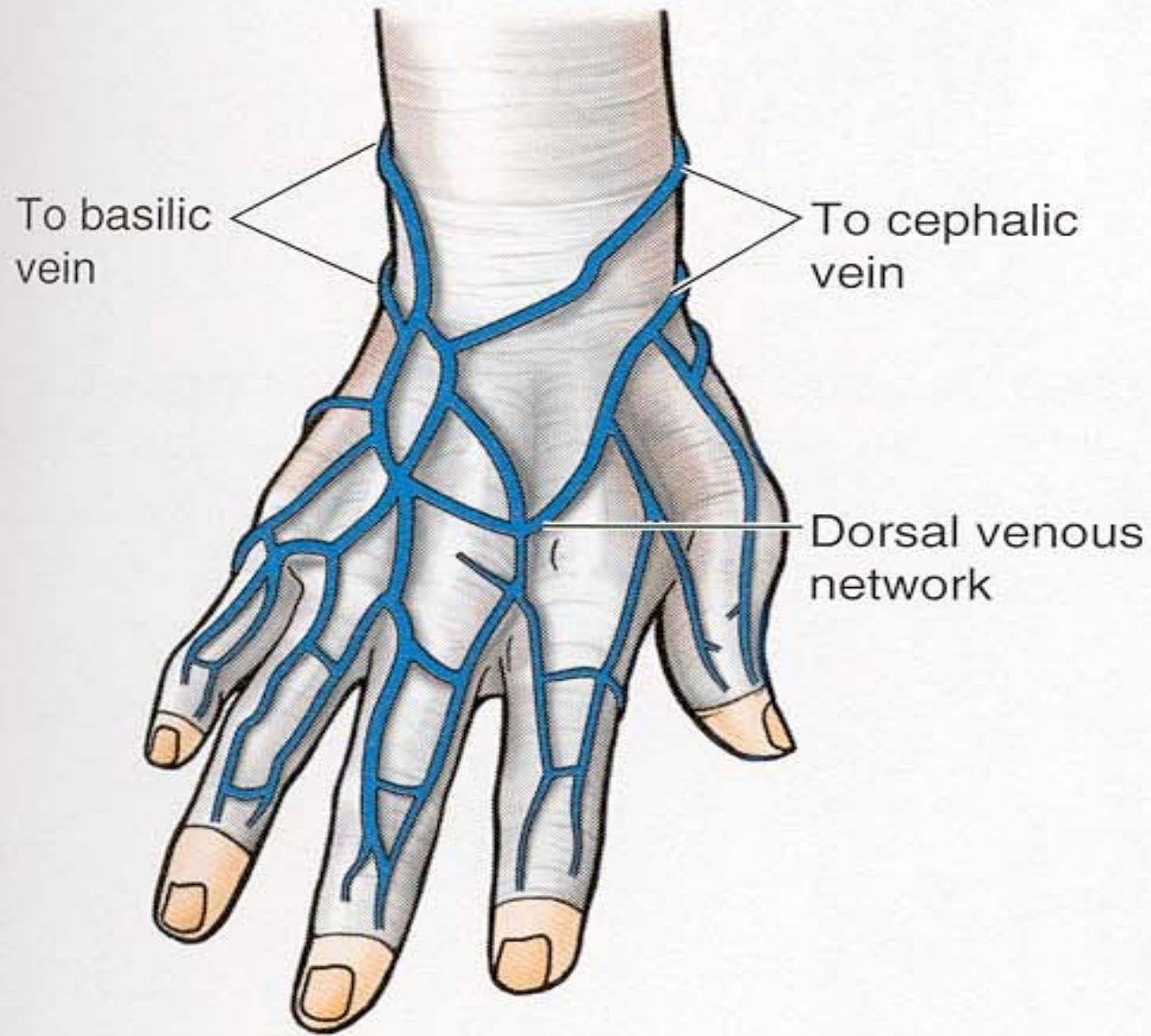
(A) Posterior view



(B) Anterior view

6.50. Deep venous drainage of the upper limb.





**(A) Posterior view**

**Superficial palmar arch,  
radial a.**

**Radial a.**

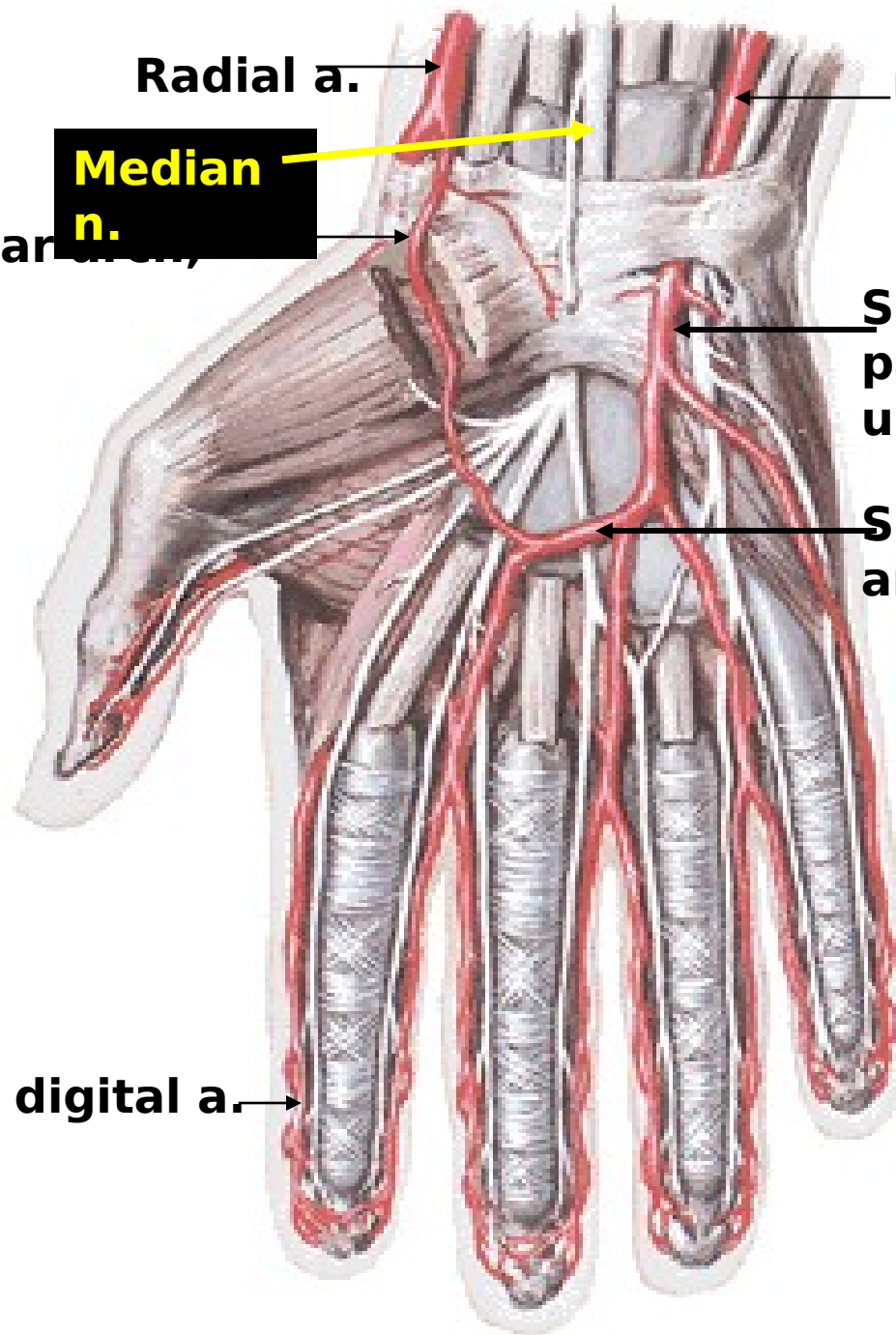
**Ulnar a.**

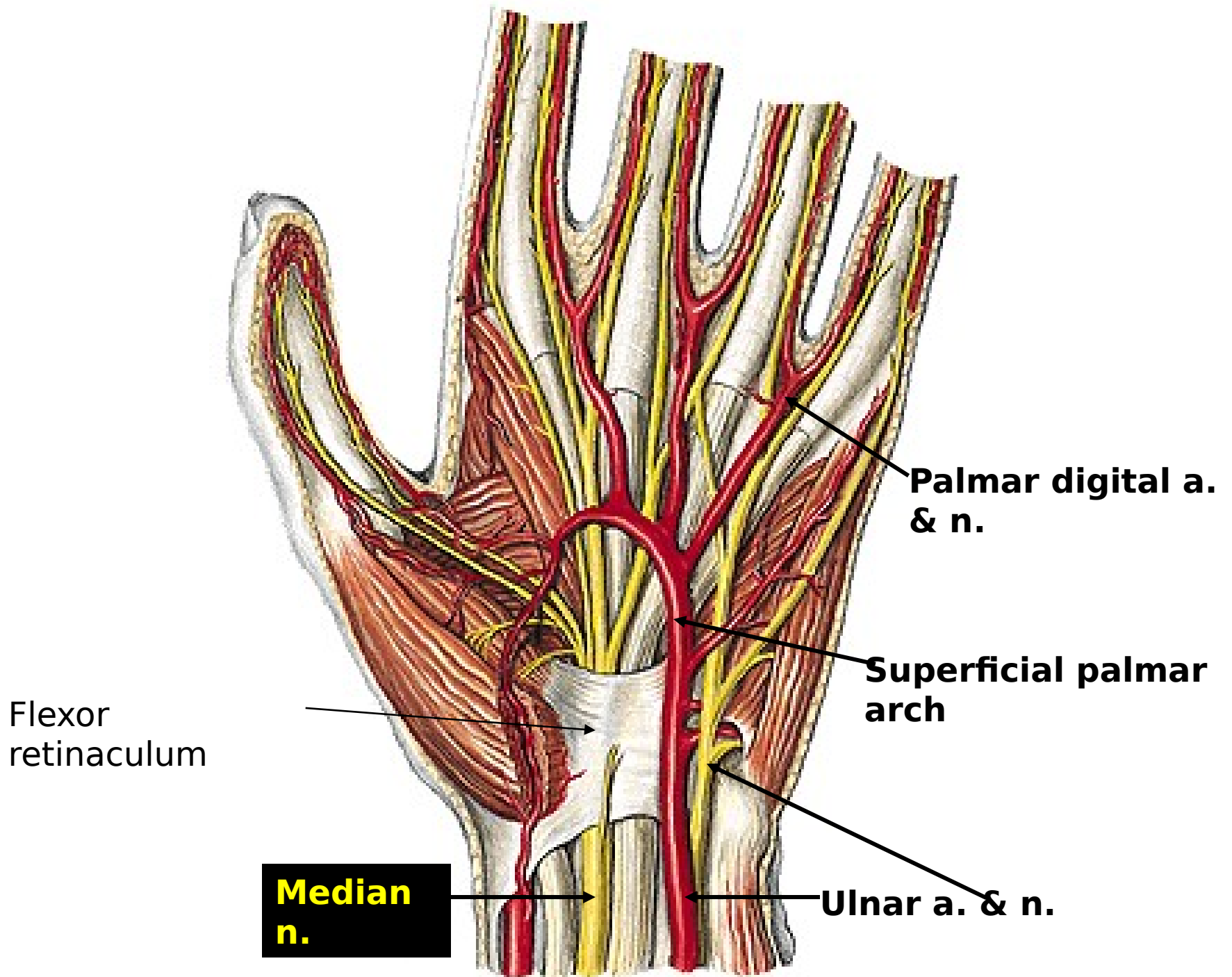
**Median  
n.**

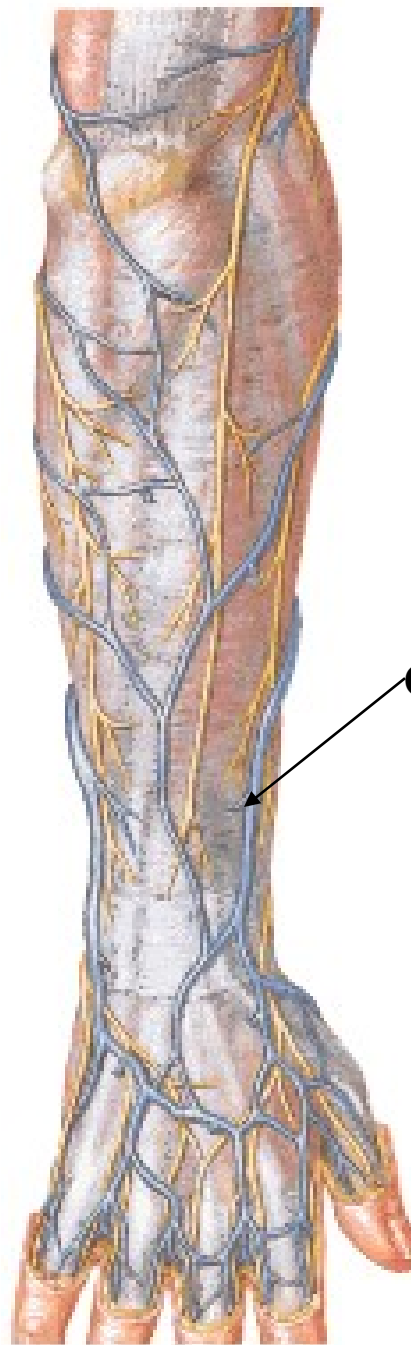
**Superficial  
palmar arch,  
ulnar a.**

**Superficial palmar  
arch**

**Proper palmar digital a.  
& n.**





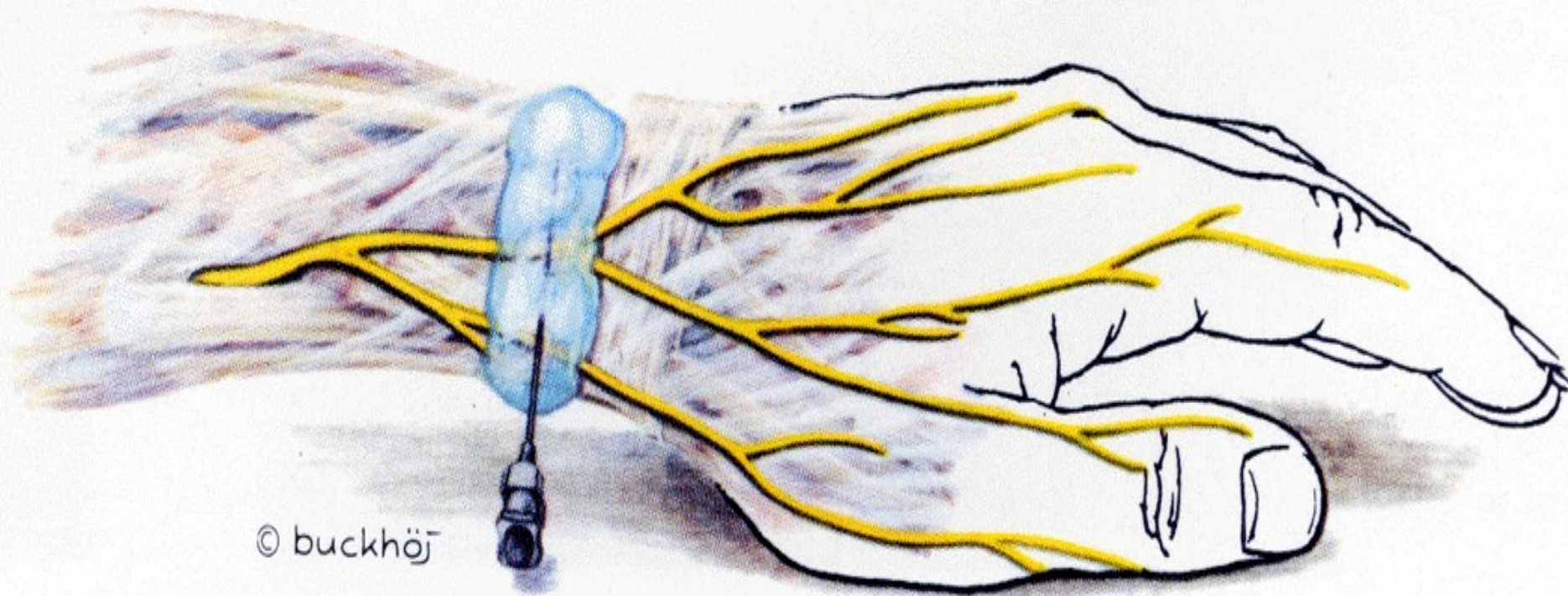


**Cephalic vein**

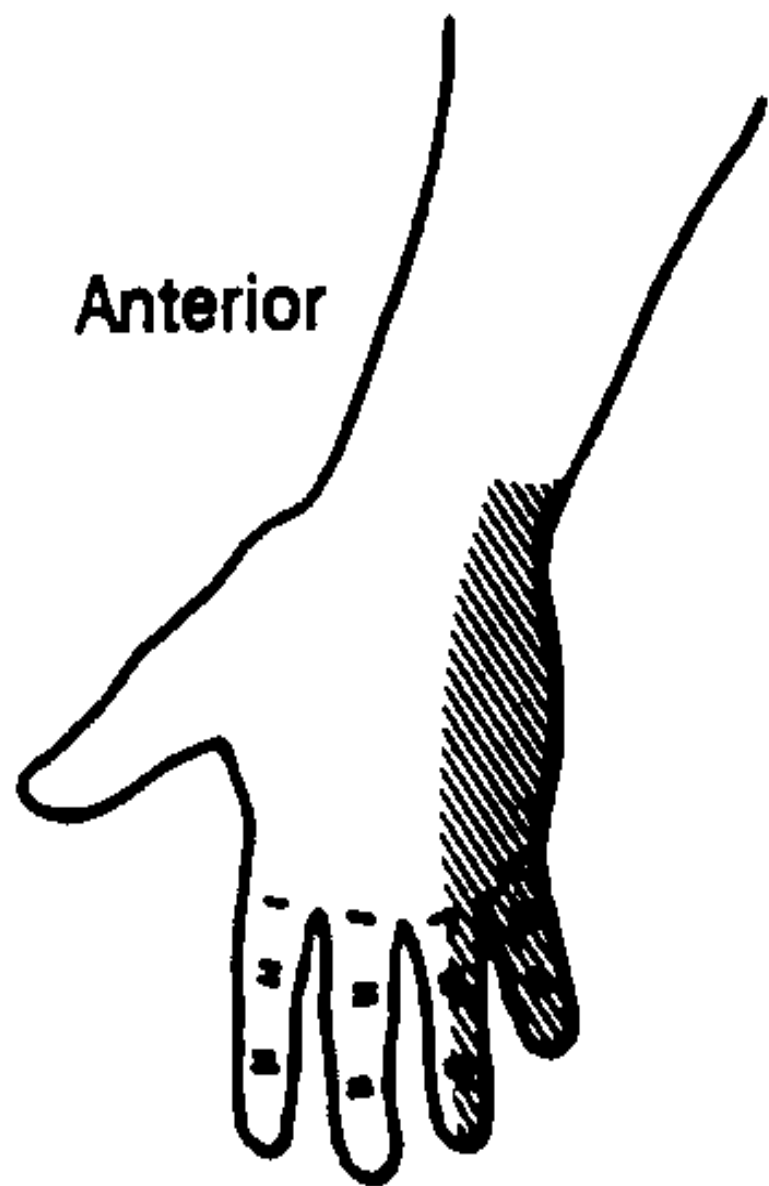
# **CUTANEOUS INNERVATION**



# Radial Nerve of Wrist

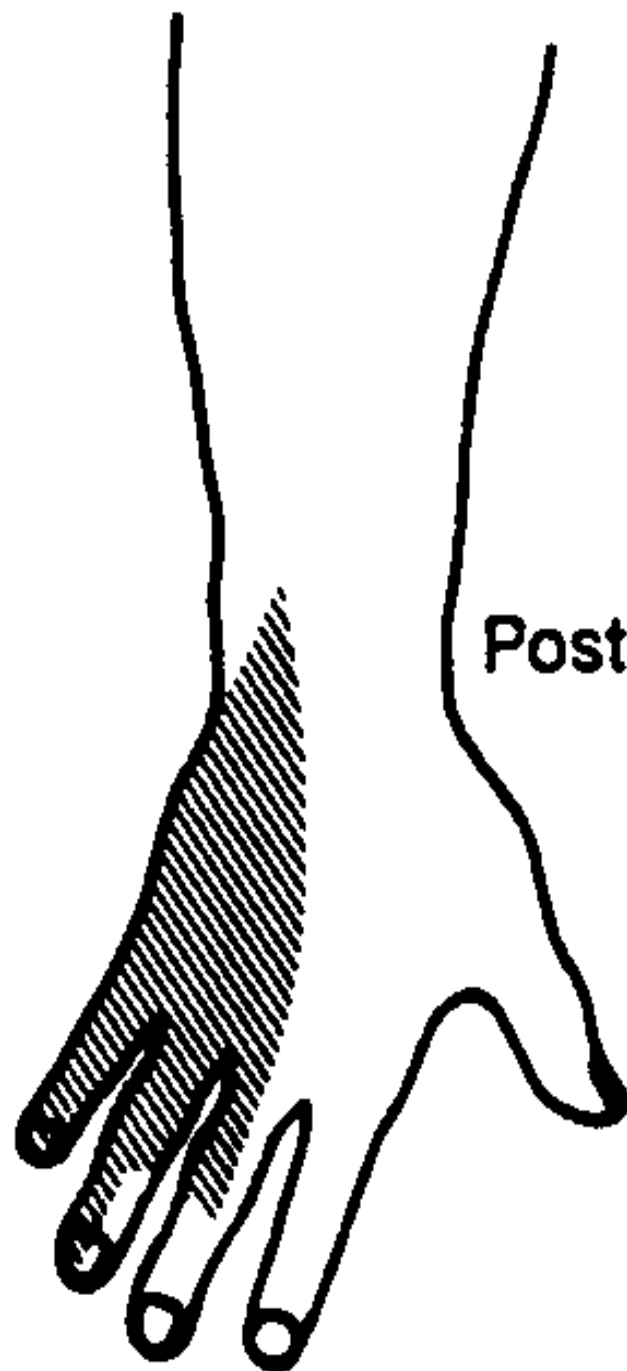


**Anterior**



**Ulnar**

**Posterior**



Lateral cutaneous nerve of forearm  
(from musculocutaneous nerve)

Medial cutaneous nerve of forearm

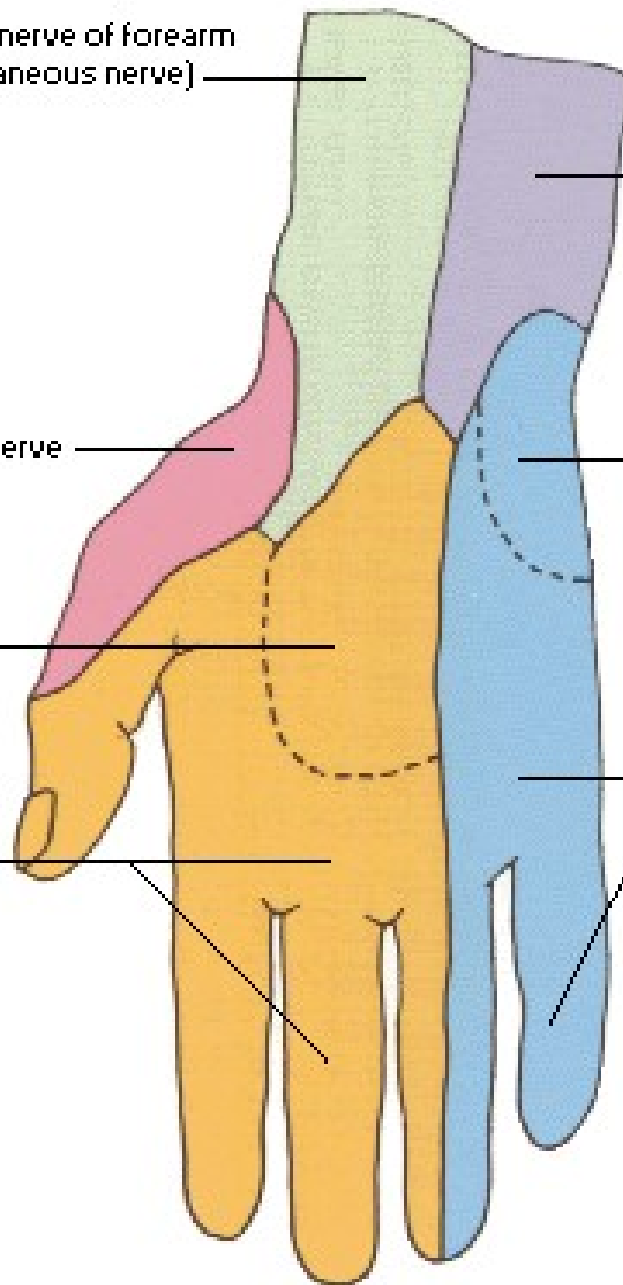
radial nerve

Palmar branch of ulnar nerve

median nerve

Palmar digital branches of ulnar nerve

median nerve



Medial cutaneous nerve of forearm

Lateral cutaneous nerve of forearm  
(from musculocutaneous nerve)

Posterior cutaneous nerve of forearm  
(from radial nerve)

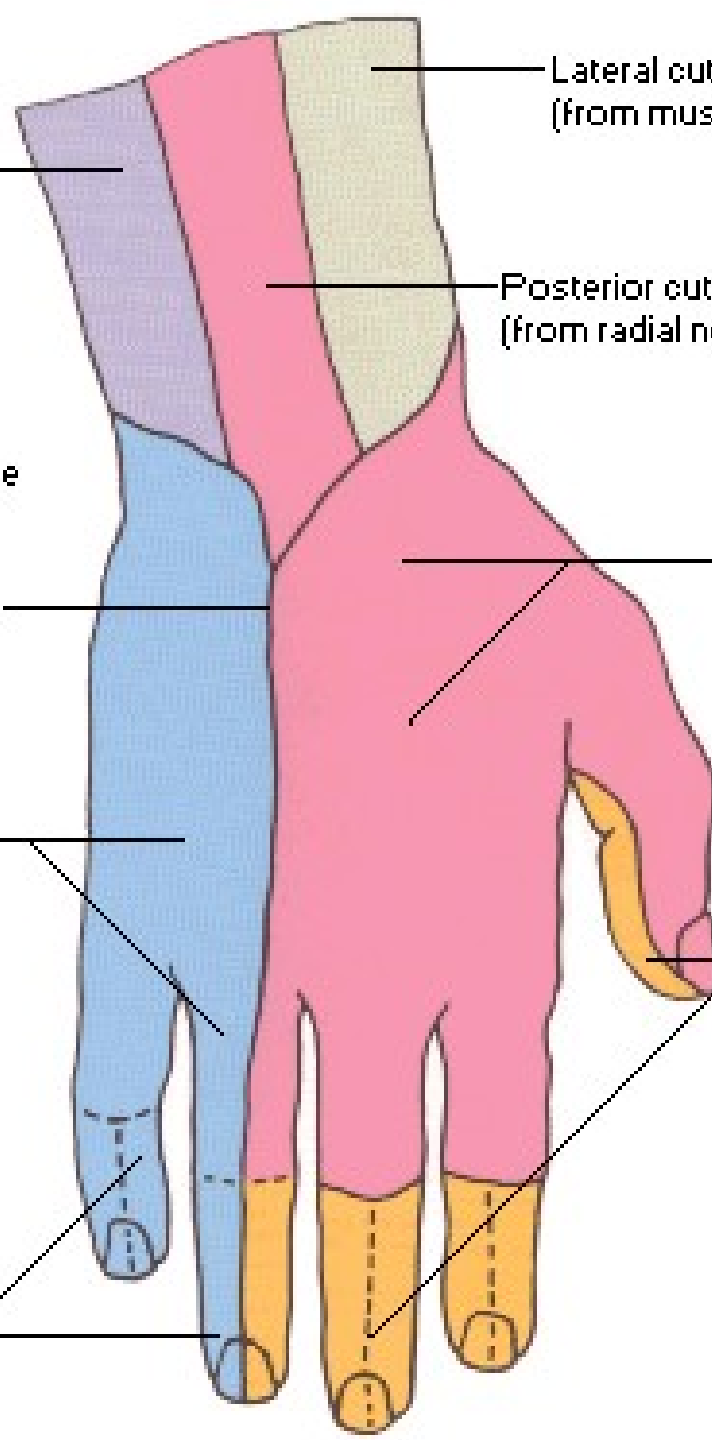
Division between ulnar and radial nerve  
innervation on dorsum of hand is  
variable; it often aligns with middle or  
3rd digit instead of 4th digit as shown

Superficial branch and dorsal  
digital branches of radial nerve

ulnar nerve

Proper palmar digital  
branches of median nerve

Proper palmar digital  
branches of ulnar nerve



**QUESTIONS**



